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Evaluation of the Extended Medicare Care Management for High Cost Beneficiaries (CMHCB) Demonstration: Health Buddy® Program at Montefiore

Final Report

Prepared for

LT Julia Zucco, PhD
Center for Medicare and Medicaid Innovation
Centers for Medicare & Medicaid Services
7500 Security Blvd
Baltimore, MD 21244-1850

Prepared by

Carol Urato, MA
Nancy McCall, ScD
Jerry Cromwell, PhD
Nancy Lenfestey, MHA
Kevin Smith, MA
Douglas Raeder, BS
RTI International
3040 Cornwallis Road
Research Triangle Park, NC 27709

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by Carol Urato, MA, Nancy McCall, ScD, Jerry Cromwell, PhD, Nancy Lenfestey, MHA, Kevin Smith, MA, Douglas Raeder, BS

Federal Project Officer: LT Julia Zucco, PhD

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CHAPTER 1
INTRODUCTION TO THE MEDICARE CARE MANAGEMENT FOR HIGH COST BENEFICIARIES (CMHCB) DEMONSTRATION AND THE HEALTH BUDDY® PROGRAM AT MONTEFIORE

1.1 Background on Phase II of the CMHCB Demonstration and the Health Buddy® Program at Montefiore Medical Center

The purpose of this report is to present the findings from RTI International's evaluation of the Health Buddy® Program at Montefiore, a Care Management for High Cost Beneficiaries (CMHCB) demonstration program jointly implemented by Robert Bosch Healthcare Systems, Inc. (RBHC) and Montefiore Medical Center's (MMC's) Care Management Organization (hereafter referred to as MMC's CMO). The Medicare CMHCB demonstration was designed to address current failings of the health care system for chronically ill Medicare fee-for-service (FFS) beneficiaries. The principal objective of the demonstration was to test new models of care for Medicare beneficiaries, who are high cost and/or who have complex chronic conditions, with the goals of reducing future costs, improving quality of care, and improving beneficiary and provider satisfaction. On July 6, 2005, the Centers for Medicare & Medicaid Services (CMS) announced the selection of six care management organizations to operate programs in the CMHCB demonstration:

1. The Health Buddy® Consortium (HBC), composed of Robert Bosch Healthcare Systems, Inc. (RBHC, formerly known as the Health Hero Network), the American Medical Group Association (AMGA), Bend Memorial Clinic, and Wenatchee Valley Medical Center
2. Care Level Management (CLM)
3. Massachusetts General Hospital (MGH) and Massachusetts General Physicians Organization (MGPO) and its Care Management Program (CMP)
4. Montefiore Medical Center (MMC) and its Care Guidance Program (CGP)
5. VillageHealth (formerly known as RMS) and its Key to Better Health program (KTBH)
6. Texas Tech University Health Sciences Center (TTUHSC) and its Texas Senior Trails (TST) program

On January 13, 2009, CMS announced that it was granting 3-year extensions, subject to annual renewal, for three participants in the CMHCB demonstration that had demonstrated some success managing the care of their selected beneficiaries: Key to Better Health, a division of Village Health; Massachusetts General Hospital Care Management Program; and Robert Bosch Healthcare Systems, Inc.'s (RBHC) Health Buddy® Program.

During the Phase II program extension period, the original Phase I Health Buddy® Program (hereafter referred to Health Buddy® West) continued to operate under the leadership and management of RBHC at Wenatchee Valley Medical Center in Wenatchee, Washington and Bend Memorial Clinic in Bend, Oregon. In addition, an adaptation of the program known as the Health Buddy® Program at Montefiore was implemented in the Bronx, NY area by RBHC and MMC's CMO. The Health Buddy® Program at Montefiore and Health Buddy® West programs

aimed to demonstrate the clinical benefit and cost effectiveness of a provider-driven, technology-based model of care management for patients with a range of chronic conditions, including those with multiple, complex chronic conditions. The Phase II program model focused on beneficiaries in the catchment areas of three delivery systems and included rural, homogeneous populations in the Pacific Northwest and an urban, multi-cultural population in the Northeast (Bronx, NY). The programs used the Health Buddy® device as an interface between patients at home and providers to facilitate communication of historical patient data and self-management support for beneficiaries with chronic conditions.

Located in Yonkers, NY, the CMO is a corporate subsidiary of MMC, The University Hospital, and Academic Medical Center for the Albert Einstein College of Medicine. MMC is an integrated delivery system that provides patient care, conducts research, and serves as a teaching hospital for the Albert Einstein College of Medicine. MMC provides a full continuum of health care services (emergency, inpatient, outpatient, and post-acute care) primarily to residents of the Bronx and Westchester County, New York.

MMC's CMO was established in 1996 as a managed services organization to contract with various independent practice associations (IPAs) to perform administrative functions and obtain and manage risk-bearing contracts. To fulfill its commitment to MMC's mission of improving health in the Bronx and Westchester, MMC's CMO supports provider-driven strategic initiatives derived from the assumption and management of risk, with medical management services, financial administration capabilities, information systems, and infrastructure to manage customer and provider relations. It supports a provider network of 2,400 credentialed professionals, managing more than 105,000 covered lives in global risk arrangements and another 74,000 lives under various specialty capitation programs. Nearly three-quarters of all Medicare Advantage members in the Bronx, or 22,700 members, are managed by MMC's CMO.

The Phase I MMC CGP was directed and operated by MMC's CMO. Designed for the frail elderly population and disabled adults, the program used a holistic approach to address the full complement of medical, psychological, and socioeconomic problems of the target population. The core of the CGP consisted of one-on-one telephone calls between program participants and Care Managers, who linked beneficiaries to necessary medical and social services. The program provided care coordination; clinical pharmacist review; links to community support services; nutritional monitoring and counseling; psychosocial support; life care planning; disease management; and telehealth (for a subset of participants).

Robert Bosch Healthcare Systems, Inc. is a wholly owned subsidiary of Robert Bosch North America which is part of the Bosch Group, a global supplier of technology and services. It comprises Robert Bosch GmbH and its roughly 300 subsidiary and regional companies in over 60 countries. In December 2007, RBHC acquired Health Hero Network, the developers of the Health Buddy® device, and transitioned into program leadership for the original Phase I Health Buddy® West demonstration program. Phase I of the Health Buddy® Program in the Pacific Northwest was successful in demonstrating some cost reduction in a rural homogeneous population with complex chronic diseases; however, RBHC felt that it would be important to extend and expand the demonstration project and to consider a number of key issues that are important in demonstrating the utility of the Health Buddy® device under a variety of conditions.

Although MMC's CGP did not receive an extension from CMS for Phase II, MMC's CMO welcomed the opportunity to continue with a new CMHCB project under the three year extension with RBHC. MMC's CMO already had one year of experience utilizing the Health Buddy® telehealth device for a small portion of their CMS demonstration population. Based on beneficiary feedback and the CMO staff's own interest in the integration of telehealth into a care management model, MMC's CMO agreed to participate in the project in order to continue serving their current population, and to study additional beneficiaries who could benefit from the model.

In Phase II, MMC's CMO and RBHC collaborated to deliver the Health Buddy® Program at Montefiore in the Bronx, NY geographic area. MMC's CMO was responsible for program implementation with oversight by RBHC. Ultimately, the MMC CMO - RBHC partnership aimed to: (1) demonstrate that the Health Buddy® Program could save health care costs in a large, diverse urban setting and in a beneficiary population that has a high concentration of frail elderly with complex medical and psychosocial needs; (2) develop best practices on how to scale the Health Buddy® program; and (3) gain an understanding of the optimal structure and best practices necessary when implementing a care management model involving practices that are not closely connected, as is the case with care provided to a large portion of the fee-for-service (FFS) Medicare population.

Information on the implementation of the Health Buddy® Program at Montefiore presented in this chapter was obtained through the conduct of semi-structured interviews. Two RTI staff participated in an in-person site visit to MMC's CMO office in Yonkers, NY on May 12, 2010. During the visit, RTI staff interviewed MMC's CMO and RBHC senior management, administrative and clinical program staff, and other key supporting staff including data analysts and technology specialists. The interviews included a range of questions related to:

- program implementation since the extension period began,
- performance monitoring/outcomes to date, and
- implementation experience/lessons learned to date.

RTI also held a follow-up telephone conference call with the RBHC project lead on May 19, 2010 to discuss follow-up questions remaining after the site visit occurred. Lastly, RTI conducted two program closeout calls with MMC's CMO program staff and RBHC program staff in June 2011 to discuss changes in the Health Buddy® Program at Montefiore since the site visit with RTI as well as RBHC's decision to terminate its CMHCB demonstration program with CMS. Participants from MMC's CMO included the Project Director, Clinical Manager, Clinical Director, Clinical Manager of Outreach, Project Manager, and Associate Vice President of Network Care Management. Participants from RBHC included the Executive Sponsor, RBHC Team Lead, Operations and Clinical Team Lead, and Account Manager.

1.2 Comparisons between the Health Buddy® Program at Montefiore and the Health Buddy® West Program

Although both the Health Buddy® Program at Montefiore and Health Buddy® West Program incorporated the fundamental concept of using the Health Buddy® device and Care

Managers to provide care management to high cost Medicare beneficiaries, a number of differences existed between the two programs. ***Exhibit 1-1*** summarizes key differences between the Health Buddy® Program at Montefiore and Health Buddy® West Programs:

Exhibit 1-1
Overview of the Health Buddy® Program at Montefiore and Health Buddy® West Program

	Health Buddy® Program at Montefiore	Health Buddy® West
Population	• Culturally/Ethnically Diverse • Multiple languages • Mean age: low 80s • Male/Female Ratio: 2:3	• Homogeneous • English speaking • Mean Age: mid 70s • Male/Female Ratio: 3:2
Geography	Urban, dense	Rural
Population Selection Methodology	No condition-specific criteria Focuses on Hierarchical Condition Categories score	Based on target conditions (HF, COPD, DM plus/minus co-morbid hypertension, IHD) and claims frequency
Delivery System	Care management subsidiary of an academic medical center-based system	Multi-specialty medical group; physicians serve large part of Medicare FFS beneficiaries in area
Program Maturity	Initiation phase requiring RBHC to provide greater oversight and management with weekly meetings and 2-3 day onsite visits most weeks	Growth and maintenance phase

NOTES: HF = heart failure; COPD – chronic obstructive pulmonary disease; DM = diabetes mellitus; IHD = ischemic heart disease; FFS = fee-for-service

- **Differences in population, geography, and cost:** The Health Buddy® West program operates in rural areas with a relatively homogenous population from a cultural/ethnic perspective (white, English as first language, etc.). The beneficiary population in the West had an average age of 74 to 75 years and was male dominant. MMC serves a heavily urbanized population. The Health Buddy® Program at Montefiore beneficiary population was older, culturally/ethnically diverse (more non-whites and Spanish and Russian as first language) and geographically dense than in the West. RBHC reported a higher overall per member per month (PMPM) cost in the New York population versus the Pacific Northwest population.

- **Differences in population selection methodology:** The beneficiary selection criteria for the Health Buddy® West program focused heavily upon targeted clinical conditions; this was the basis for population selection in the Phase I Health Buddy® program. The

population for the Health Buddy® Program at Montefiore was chosen via a selection model that used no condition-specific criteria and that, instead, used Hierarchical Condition Category (HCC) scores; this was the basis for population selection in MMC's CMO Phase I demonstration project.

- **Differences in delivery-system characteristics:** The Health Buddy® West program operated within two multi-specialty medical group practices whose physicians serve a high percentage of the Medicare fee-for-service (FFS) populations in their areas. MMC's CMO is a care-management program that is a subsidiary of an academic medical center-based system (Montefiore Medical Center and Albert Einstein Medical School). The system is integrated for the large managed care population it serves, but is less integrated and more fragmented for the FFS Medicare population in the Bronx, which uses more of the system's "voluntary" versus employed physicians who tend to be solo and small group physicians.

- **Differences in program maturity:** RBHC classified the Health Buddy® West program as residing in a growth and maintenance phase during the time that the Health Buddy® Program at Montefiore underwent an initiation phase. As a result, RBHC provided greater oversight and management to the Health Buddy® Program at Montefiore with weekly meetings and 2-3 day onsite visits most weeks.

1.3 Health Buddy® Program at Montefiore Intervention and Comparison Populations

Intervention population. A condition of MMC's CMO participation in Phase II was to maintain the same diagnostic and utilization inclusion and exclusion criteria in Phase II that it used for participant identification in Phase I. However, the Health Buddy® Program at Montefiore was allowed to add 2 more hospitals from the Montefiore network, Bronx Lebanon and St. Barnabas, and to expand into 8 more ZIP codes from Central and South Bronx for identification of its intervention population. Inclusion criteria for eligibility included:

- Medicare FFS beneficiaries with a primary residence in one of 24 designated ZIP codes in Bronx, New York surrounding MMC as of August 3, 2009, with a high level of disease severity as indicated by Hierarchical Condition Categories (HCC) community risk score of 1.6 or greater.

- Two visits to MMC physicians between April 1, 2008 and March 31, 2009, or one visit to MMC physicians in the 12-month claims period with no visits to other physicians, or a plurality of visits to MMC inpatient facilities, or one visit to an MMC inpatient facility and no visits to other inpatient facilities.

- Absence of selected conditions as indicated by ICD-9 diagnosis codes and DRG codes obtained from claims data, including dementia, substance abuse, and schizophrenia, among others.

The population was further restricted using the following exclusion criteria based on a September 22, 2009 Medicare Enrollment Data Base (EDB) check of beneficiary status or from Medicare claims data:

- age less than 45,
- receiving the Medicare hospice benefit,
- receiving the Medicare end-stage renal disease (ESRD) benefit,
- history of dialysis treatment,
- residing in a skilled nursing facility (SNF) or nursing home,
- enrolled in a Medicare Advantage (MA) plan,
- Medicare as a secondary payer, or
- no Medicare Part A or Part B coverage.

Lastly, beneficiaries who were participating in other demonstrations were excluded after sending a finder file of identification numbers to Mathematica Policy Research (MPR). Using these criteria, the Phase II population consisted of 4,466 (ARC) Medicare FFS beneficiaries. Because of a delay in receipt of beneficiary identifying information by the Health Buddy® Program at Montefiore, a subsequent check of eligibility as of December 1, 2009 yielded 4,310 beneficiaries eligible for the Phase II intervention population. In addition, the Health Buddy® Program at Montefiore was also allowed to transition beneficiaries from the Phase I Original and Refresh populations into Phase II, if they continued to meet demonstration eligibility criteria as of June 1, 2009. A total of 1,743 Phase I Original population beneficiaries and 671 Phase I Refresh population beneficiaries were transitioned into the Phase II Health Buddy® Program at Montefiore.

Comparison population. Similar to the process it followed in Phase I**,** RTI developed specifications to select a Phase II comparison group of beneficiaries to be used in conducting the financial reconciliation and evaluation of this CMHCB demonstration program. The Phase II comparison group was selected using the following eligibility criteria, using an expanded geographic area and two additional hospitals for determining loyalty:

- Medicare FFS beneficiaries with a primary residence in 20 ZIP codes in Brooklyn and Manhattan surrounding 7 comparison hospitals with household income levels and proportions of Hispanic residents similar to the intervention ZIP codes with a high level of disease severity as indicated by HCC scores of 1.6 or greater.
- A plurality of visits to at least 1 of the comparison group's physician group practices (identified by tax identification number), 1 visit to a comparison group practice and no visits to any other physicians, or a plurality of admissions to 1 of 7 inpatient facilities or 1 admission to a comparison hospital and no admissions to any other hospitals.
- Absence of selected conditions as indicated by ICD-9 diagnosis codes and DRG codes obtained from claims data, including dementia, substance abuse, and schizophrenia.

The exclusion criteria that were applied to the intervention group were also used to limit the comparison group (i.e., age less than 45, receiving the Medicare hospice benefit, receiving the Medicare ESRD benefit, history of dialysis, enrolled in an MA plan, Medicare as a secondary payer, lack of Medicare Part A or Part B coverage, or residence in a SNF or nursing home), and potential comparison group beneficiaries participating in other demonstrations were also deleted. Determination of eligibility was made as of December 1, 2009.

In order to ensure that the comparison group had baseline Medicare costs similar to the intervention group, the comparison group members were randomly selected from each of five cost strata representing the cost quintiles observed in the intervention population. The number of comparison beneficiaries selected from each stratum was determined by the number of intervention beneficiaries in each stratum. The final Phase II comparison group size was 4,325 Medicare FFS beneficiaries. The Phase I Original comparison population that transitioned to Phase II consisted of 1,060 Medicare FFS beneficiaries; while the Phase I Refresh comparison population consisted of 612 Medicare FFS beneficiaries. Eligibility was determined as of June 1, 2009.

1.4 Health Buddy® Program at Montefiore

1.4.1 Overview

MMC's Phase I Care Guidance Program (CGP) was a case management program designed for the frail elderly population and disabled adults that used a holistic approach to address the full complement of medical, psychological, and socioeconomic problems of the target population. Each program participant received interventions tailored to his or her specific needs. The core of the CGP consisted of one-on-one telephone calls between participants and Care Managers, who linked beneficiaries with needed medical and social services. The program provided the following specific services to participants:

- care coordination
- clinical pharmacist review
- link to community support services,
- nutritional monitoring and counseling
- psychosocial support
- life care planning
- disease management
- telehealth

Beneficiaries could participate in any or all of the program elements during the demonstration program, depending on their needs throughout the period. Participants were assigned to a care team based on the location of their residence and the primary language that they speak. The CGP hired Russian- and Spanish-speaking staff including a Spanish-speaking licensed practical nurse (LPN), a Spanish-speaking nutrition counselor, and a Russian-speaking social worker. Each care team used the following basic strategy to support participants:

- assess participant problems and resources and develop care plan to address identified needs;

- implement and deliver interventions to address participant problems; and

- re-assess status on a regular basis and adjust care plans based on changes in participant problems and resources.

The Health Buddy® Program at Montefiore program model was comprised of a combination of CGP's centralized telephonic care management and integration of the Health Buddy® telehealth device into care management activities. It provided the following services for participants:

- **In-home monitoring.** Participants answered questions about signs and symptoms they experienced on the Health Buddy® device and answers were sent electronically to a Care Manager. Care Managers followed-up with the beneficiary and/or the beneficiary's physician as needed.

- **Improved access to health services and health care coordination.** Care Managers and Patient Educators assisted with appointment scheduling, helped with the coordination of health care-related services provided by multiple providers or facilities, and provided information on medically necessary medical equipment.

- **Medication adherence.** The program's pharmacist was available to discuss medication concerns with participants and also consult physicians, as needed.

- **Health education**. Information and educational materials were provided to beneficiaries about their specific illnesses. Nurses were available to answer questions about beneficiaries' condition and treatment plan.

The care management model was modified to incorporate telehealth tools to positively impact the frail elderly population residing the program's target area of the Bronx who may or may not utilize the service network of the Montefiore system. A total of 17 Health Buddy® programs were available to Health Buddy® Program at Montefiore participants in English and Spanish:

- Coronary Artery Disease (CAD)
- CAD/Diabetes
- CAD/Hypertension (HTN)
- Caregiver
- Chronic Pain
- Chronic Obstructive Pulmonary Disease (COPD)
- COPD/Diabetes
- COPD/Heart Failure (HF)
- COPD/HF/Diabetes
- COPD/HTN
- Diabetes
- Health Heart
- HF
- HF/Diabetes
- HTN
- Senior Wellness/Diabetes
- Senior Wellness/Maintenance

Beneficiaries who were excluded from or who refused to use the Health Buddy® device were offered the Alternate program that consisted of regular telephonic care management services without the device. In the Alternate program, as in the group of participants who used the Health Buddy® device, participants received assistance from their Care Manager as well as

from other members of the team including pharmacy, social work and patient educators. Alternate program participants were called a minimum of once per month.

The start date for the Health Buddy® Program at Montefiore's Phase I Care Guidance Program's legacy population[1] was June 1, 2009. The program for the Phase II population began on December 1, 2009. According to RBHC, implementation during the extension period resulted in a tremendous learning experience for all members of the team. The needs of the population that were identified in the outreach, enrollment, and engagement processes challenged both RBHC and MMC's CMO to move from their traditional models and contribute to the development of an integrated program design and implementation. Furthermore, the need to scale this program over a relatively short period of time necessitated the use of third party providers for outreach and installation, which required the development of processes and metrics to monitor and manage beneficiary recruitment, product installation, and care management in three languages.

For the CGP, MMC's CMO used variants of relatively simple senior wellness clinical subject matter. The clinical content used for the Phase II program was more disease-focused. Clinically-based Health Buddy® device programs were selected for participants according to participants' individualized medical conditions. Alerts generated by participants using the Health Buddy® telehealth device to answer daily surveys were monitored Monday through Friday in coordination with telephonic care management support, and referred to other members of the care management team. Upon completion of the enrollment and installation processes, consistent use of the device and regular contact with care management were measured, resulting in follow-up calls to encourage continuity of usage and to troubleshoot any challenges that may arise. Routine monitoring of participant health status and symptoms through risk stratification of participant responses alerted Care Managers to health issues that resulted in early intervention before those issues resulted in serious complications that required hospitalization.

In the majority of cases, the clinical teams were dedicated to either managing participants on the Health Buddy® device or to managing participants in the Alternate telephonic care management program. These changes required a change in workflow for the clinical teams that were dedicated to the participants using the Health Buddy® device. Furthermore, it required that the Care Managers learn the triggers of red and yellow alerts, categorized by level of seriousness and type of alert (e.g., symptom/behavior, hospital discharge, knowledge/general) to allow them to appropriately prioritize their care management activities.

Formerly, with the Phase I CGP, data collection was conducted using the Montefiore CareEnhance Clinical Management Software (CCMS). MMC adapted the McKesson CCMS information system to support Care Guidance program operations. The system tracked participant information, including program eligibility, health status, and health care utilization, and provided updated participant information to support the work flow of CGP staff. Using data collected during the baseline and follow-up assessments, the CCMS system assigned participants

[1] Participants of the Phase I CGP that carried over as participants of the Health Buddy® Program at Montefiore expansion in Phase II.

to stratification levels based on the types of problems to be addressed and the intensity of interventions and care management efforts needed.

The Phase II model utilized an intake process whereby assessment and clinical program assignment were determined upfront and followed by ongoing assessment and intervention using the Health Buddy® device and specific disease content selected for the beneficiary. A more sophisticated reporting shared server was built with MMC's CMO to provide additional decision support capability. The reporting system combined data available in the Health Buddy desktop system, the companion system, and some additional information from the PRISM outreach and inventory system. The primary metrics most heavily utilized pertained to engagement. The metrics were monitored every week so that MMC's CMO staff could follow up on non-responders and to ensure completion of baseline assessments.

1.4.2 Staffing and Management Structure

The program maintained two clinical teams, each composed of five people supporting care management for approximately 450 participants per team: one Registered Nurse (RN) Team Leader, three Licensed Practical Nurses (LPNs) that serve as Care Managers, and one Patient Educator. Other specialists that supported the care management team included: a Medical Director, Pharmacist, Palliative Care Nurse Practitioner, and Manager of Training and Development. During the course of Phase II, high case manager/participant ratios led to the addition of additional Care Managers to reduce case manager/participant ratios from 200:1 to 150:1. A change in RBHC oversight of the Health Buddy® Program at Montefiore occurred in March 2010 due to the departure of the previous team leader and the need to significantly increase recruitment and installation within a short period of time. There were no changes in MMC's CMO leadership team between Phase I and Phase II or during Phase II.

1.4.3 Outreach, Engagement, and Installation

The Phase II population was initially contacted for recruitment by third party outreach specialists, PRISM (Productivity, Resources, Integration, Sales, Marketing) Services Inc. Given that the program's recruitment goals were not being met, program administrators continued to place heavy emphasis on recruitment efforts throughout a longer than anticipated period of Phase II. Follow-up was performed by the outreach specialists in conjunction with Health Buddy® Program at Montefiore staff. To help focus recruitment, priority was given to those beneficiaries whose predicted resource utilization was high, those with 4+ hospital admissions in the prior year, and those coming out of a hospital and skilled nursing facility. Further, RBHC supported one full-time staff member to assist with engagement as well as other temporary staff to help with engagement of new beneficiaries and re-contacting early refusals.

New in Phase II, the majority of beneficiaries received a home visit from BLN, a local durable medical equipment company, for installation, connection, and orientation to their Health Buddy device in order to reduce connection issues and to decrease disenrollment due to "technophobia." This program expanded over time from an expectation that approximately one-third of participants would require in-home installation (with direct shipment to the other two thirds of participants) to nearly 100% home installations due to the high volume of installations and connection issues. This high volume of home installations was attributed to the large number of older apartment buildings with poor electrical and telephone wiring in the Bronx, and

a beneficiary population that was elderly and had limited understanding of even simple technology. Thus, RBHC made a significant change from direct-ship and self-install of the Health Buddy device to a complete home installation effort. RBHC also converted to nearly 90% installation using a cell modem because a large percentage of beneficiaries did not have landlines.

To further expedite and supplement installations conducted by BLN, RBHC established a contract with another company, CareManagers, Inc. (CMI), to help with in-home set-up and to gather intake information. The installation vendor was also very useful in providing the case managers with information on the actual patient situation in the home. The range of services provided during the visits included: orientation, enrollment, intake, and home assessment and teaching, in addition to routine installation of the Health Buddy® device and connection equipment. The type of visit was scheduled based on information obtained in the enrollment and/or scheduling process. Fees paid to CMI varied depending on the services provided ($25-$75 for retrieval or no-show/ troubleshooting/ reinstallation), up to $150 (orientation, installation, and intake). In addition, CMI provided scheduling for which they were compensated at an hourly rate. MMC's CMO maintained oversight of day-to-day management of the outreach and installation efforts.

1.4.4 Fees and Payment Structure

RBHC assumed full risk for the Health Buddy® Program at Montefiore in Phase II. The Health Buddy® Program at Montefiore received $132 per member per month (PMPM), with RBHC paying MMC's CMO $65 PMPM. CMS revised the risk sharing formula to 2.5% savings plus fees for the Phase II cohort of beneficiaries. Thus, in Phase II the required savings are 5% for the Phase I Original beneficiaries and 2.5% for the Phase I Refresh beneficiaries and the Phase II beneficiaries.

MMC's CMO used a portion of the payments it received to fund installation and outreach costs. Given that RBHC and MMC's CMO did not initially predict that the majority of Health Buddy® device installations would require home visits, the costs associated with installation and outreach were greater than anticipated. At the time of our site visit, RBHC and MMC's CMO were in the process of renegotiating the originally negotiated payment rate to account for the greater than anticipated installation and outreach costs that MMC's CMO incurred.

1.4.5 Relationship Management

The Health Buddy® Program at Montefiore's centralized care management structure provided significant economies of scale for MMC's network of physicians. Two primary factors facilitated communication with the program's clinical practice partners: physicians' familiarity with the previous CGP and use of the same email system. MMC's clinical practice partners were familiar with the MMC care management model as a result of their past experience with and knowledge of the CGP. Both physicians and Care Managers found the availability of tangible, objective Health Buddy® data to be useful during their interactions, in that the data allowed the Care Managers to easily and efficiently pinpoint patient-specific findings and trends. Care Managers' use of the same email system as MMC's physicians was also helpful in facilitating communication with physicians.

MMC's CMO managed physician outreach efforts for the program consisted of mailings and face-to-face visits. MMC had access to data on physicians in the catchment area with a high volume of eligible beneficiaries and used this information to prioritize physician outreach. Staff reported that the program maintained strong relationships with local hospitals, skilled nursing facilities, and other care agencies. The program's physician liaison assisted with inpatient recruitment and also facilitated physician communication for Care Managers who had difficulty reaching physicians. RBHC leadership provided a high level of program support and was very involved with the program since project initiation.

Regarding the program leadership's relationship with CMS, unlike Phase I in which there was a dedicated CMS project lead that facilitated rapid response to issues and questions, in Phase II, CMS used a team approach to manage the Health Buddy® Program at Montefiore and Health Buddy® West, which some site visit participants felt hindered communication.

1.5 Factors Leading to Program Termination

MMC's CMO and RBHC staff identified a number of factors that contributed to the decision to terminate the program:

- Approximately 1,000 beneficiaries had telephone numbers that were not correct or operational and were therefore considered unreachable. Thus, about 1,000 beneficiaries out of 6,000 Phase II beneficiaries were not reachable at all.

- Program staff felt that the new "once out always out rule" eligibility criterion imposed during Phase II reduced their ability to keep beneficiaries actively participating. A number of beneficiaries lived in other locations during the winter and became ineligible for the program when they changed their mailing address for the winter. ***Table 2-4*** provides first reason for ineligibility. Approximately 5% of beneficiaries may have been affected by this decision.

- Another challenge noted was the 6-month delay in receiving the program's Phase II population from CMS. This presented staffing challenges as well as shortened the length of time the program staff would be able to work with the Phase II population.

- From RBHC's perspective, a key issue that contributed to the decision to terminate the program originated at the beginning of Phase II when it became clear that performance during the Phase II program period for the Phase I Original and Refresh populations would be evaluated against their baseline period which was greater than three years old.

- In RBHC's program termination letter to CMS, they identified three issues that they felt were beyond their control and that contributed to the program's lack of success in achieving the savings target for the intervention group: mortality, cost, and time.

    - Regarding mortality, RBHC staff reported that analyses were performed by Derek Newell, the former president of RBHC (who is no longer with RBHC) using ARC data and looking at each of the groups and the ratio of intervention to control mortality rates for each cohort by quarter. He concluded that in the early phase of the project, the intervention group was dying at a higher rate than the control

group and this was happening from the first month of the project forward. This raised a question as to whether this was an equitable control group.

- RBHC also expressed significant concern about the length of time the beneficiaries would actually be on the intervention in order to make up any of the cost issues seen early on in the intervention (beneficiaries would not be on the program long enough to make changes necessary to drive results). Staff noted that the slow engagement process was more of an issue than lack of total engagement, as it took until August 2010 for the program to hit peak enrollment.

- RBHC mentioned that MMC's CMO requested that everyone begin with just the health wellness program on the Health Buddy until program staff had time to conduct outreach, individual assessment, and assign a tailored Health Buddy® program. Although participants were on the wellness program, RBHC staff felt that not being on a program tailored specifically for their health outcomes prevented the program from having the greatest potential impact. They reported that the enrollment timeframe was too short to make the impact once the participants were on board.

1.6 Lessons Learned

When asked if there were particular aspects of the Health Buddy® Program at Montefiore that could have been changed to better serve their intervention population, interviewees noted the following:

- The Health Buddy® West program selection criteria were more disease-specific whereas there was no disease identification for the Health Buddy® Program at Montefiore. Although RBHC requested from CMS that the Health Buddy® Program at Montefiore Phase II program use a similar identification algorithm, this request as not granted. Program staff reported that more general criteria resulted in a small number of beneficiaries identified with a disease such as osteoarthritis that could not be well-supported through the Health Buddy® device.

- Further, Health Buddy® Program at Montefiore staff reported that problems arose with patients who had claims-based diagnoses of heart failure, but who had not been told by their healthcare provider that they had heart failure. Health Buddy® scripts were modified to deliver heart failure content without referencing heart failure.

- A pervasive barrier with MMC's CMO was the lack of integration in the physician community. Additionally, if the patient had a relationship with a number of physicians or with a physician outside the Montefiore network it became more challenging to tie in the physician piece.

- RBHC believes the Health Buddy® device is a critical component because its unique content sets it apart from other patient monitoring interventions, but ultimately the care management process is most important. RBHC staff felt that implementation of care management standard operating procedures (SOPs) was faster and more comprehensive in the Health Buddy® West program. Although RBHC developed similar SOPs for the

Health Buddy® Program at Montefiore, RBHC staff felt that implementation of the SOPs was slower and less comprehensive, thereby negatively impacting outcomes.

When asked if there were particular successes of the Health Buddy® Program at Montefiore, interviewees identified the following as program successes:

- Health Buddy® Program at Montefiore program staff built strong relationships with the beneficiaries they managed.

- Program staff had success using a rigorous follow-up process to re-engage beneficiaries and increase compliance who did not respond to the Health Buddy® surveys as often as desired.

- Despite recruitment challenges, 25% of the intervention population was successfully engaged. Moreover, beneficiaries on the Health Buddy® device generally used it fairly consistently, resulting in a high level of interaction between care managers and the participants.

- Cellular modems were introduced when lack of telephone landlines was recognized as an issue. This allowed successful engagement of beneficiaries who initially were unable to use the Health Buddy® device.

- Program staff reported they had considerable success getting beneficiaries access to care, including timely doctor appointments, and community resources. Staff reported that they empowered beneficiaries by teaching them what to say on the phone when trying to make an appointment.

We also asked interviewees of the lessons learned what would influence future work the area of care management or with CMS demonstrations.

1.6.1 RBHC Staff

- RBHC staff found the experience of implementing the program in an urban site to be very valuable. It was particularly helpful to learn the significant differences between the Health Buddy® West program and the Health Buddy® Program at Montefiore and the additional programs that had to be developed to scale up in an urban environment.

- RBHC staff felt it was important that CMS allow a ramp up period for recruitment to begin to facilitate having everything in place beforehand to facilitate installation, recruitment, and training of people on site.

- RBHC staff reported that the program provided them with the opportunity to develop a comprehensive programming approach that included physician engagement, using creativity to bolster patient-physician relationships, and identification of intervention strategies for patients.

- Telehealth requires some relationships beyond the care manager to help patients become accustomed to and see value in the program.

- RBHC staff believes that physicians must be as closely involved as possible. Although nurses do not necessarily need to be embedded with the physicians, there must be a relationship where physicians have a vested interest in making sure they're involved.

- Lack of access to an EMR. Although information regarding patient admissions to Montefiore hospital was available on a daily basis, information was more limited from an integrated perspective as physicians were not provided information on a timely basis.

- RBHC staff felt that the Health Buddy® Program at Montefiore lacked a strong physician advocate, which RBHC believes is a really important feature of care management/coordination interventions.

- Having beneficiary contact information before program launch is critical. Names of beneficiaries and contact information were unavailable at the start of Phase II and the 6 months following.

1.6.2 MMC's CMO Staff

- CMO program staff felt that recruitment during Phase I was more successful because program staff conducted the enrollment, were familiar with the specifics of the program, and were immediately able to answer the beneficiaries' questions, thereby resulting in higher engagement rates. They suggested that future programs should allow program staff to manage the outreach and engagement piece.

- They also felt the Phase I program had a stronger hospital presence to identify beneficiaries who would be appropriate for the program but who were initially declined. In Phase II, there were limited resources devoted to this effort.

- Program staff reported that they experienced difficulty identifying and isolating primary care physicians for their assigned beneficiaries. Not being limited to certain practices or clinics resulted in approximately 10,000 providers physically located across many locations. Higher volume physicians were easier to identify and target for outreach to gain their support in the recruitment process. However, they reported that there was no concentrated marketing campaign around the providers.

- CMO program staff reported the following beneficiary characteristics as positively associated with program participation:

  - Beneficiaries who had a limited number of health issues. Those with fewer health issues were not so sick that education about the disease process was useless.

  - Beneficiaries who had an existing relationship with the program from Phase I and agreed to continue participation in Phase II and use the Health Buddy® device in order to continue receiving services.

- In contrast, beneficiary characteristics that were identified as negatively associated with participation included:

  - Beneficiaries who were more frail or who experienced cognitive, visual, hearing, tactile, or functional impairments making use of the Health Buddy® device more difficult.

  - Beneficiaries who resided in small apartments which presented difficulties in finding space and electrical outlets for the Health Buddy® device.

- CMO program staff reported that CMS did not approve the Health Buddy® Program at Montefiore's letter to beneficiaries and limited what could be said to participants, resulting in beneficiaries receiving letters who should not have received them, and insensitivity toward the relationships that had been established. Staff reported that some beneficiaries would have been a good fit for enrolling in a managed care plan but staff members were unable to make that suggestion. Further, staff would have preferred to have made calls to all participants to make sure they were "tucked in" and had services lined up that they needed.

CHAPTER 2
EVALUATION DESIGN AND DATA

2.1 Overview of Evaluation Design

2.1.1 Gaps in Quality of Care for Chronically Ill

Medicare beneficiaries with multiple progressive chronic diseases are a large and costly subgroup of the Medicare population. The Congressional Budget Office (CBO) estimated that in 2001 high-cost beneficiaries (i.e., those in the top 25% of spending) accounted for 85% of annual Medicare expenditures (CBO, 2005). Three categories of high-cost users—beneficiaries who had multiple chronic conditions, were hospitalized, or had high total costs—were identified by CBO for study of persistence of Medicare expenditures over time. Beneficiaries that were selected based upon hospitalization or being in the high total cost groups had baseline expenditures that were four times as high as expenditures for a reference group. Beneficiaries selected based upon presence of multiple comorbid conditions had baseline expenditures that were roughly twice as high as expenditures for a reference group. Subsequent years of costs remained higher for all three cohorts than the reference group; however, total expenditures declined the most for those beneficiaries who were identified as high cost due to a hospitalization followed by beneficiaries who had had high total costs in the base year. Subsequent costs were virtually unchanged for beneficiaries with multiple chronic conditions.

Further, these beneficiaries currently must navigate a health care system that has been structured and financed to manage their acute, rather than chronic, health problems. When older patients seek medical care, their problems are typically treated in discrete settings rather than managed in a holistic fashion (Anderson, 2002; Todd and Nash, 2001). Because Medicare beneficiaries have multiple conditions, see a variety of providers, and often receive conflicting advice from them, there is concern that there is a significant gap between what is appropriate care for these patients and the care that they actually receive (Jencks, Huff, and Cuerdon, 2003; McGlynn et al., 2003). The CMHCB demonstration has been designed to address current failings of the health care system for chronically ill Medicare fee-for-service (FFS) beneficiaries.

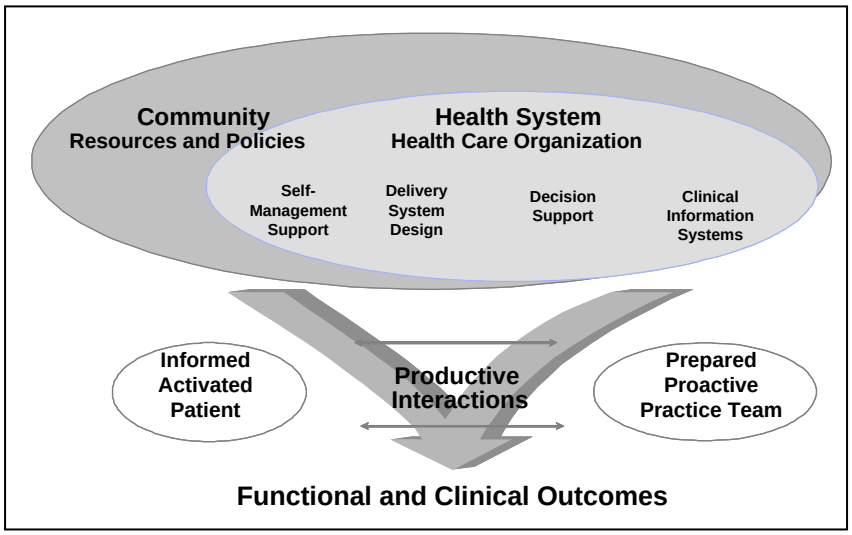
2.1.2 Emerging Approaches to Chronic Care

The Chronic Care Model—The concept of chronic care management as a patient-centered and cost-effective approach to managing chronic illness has been evolving for years. The Chronic Care Model (CCM), developed by Wagner (1998), has become a familiar approach to chronic illness care (***Figure 2-1***). This model is designed to address systematic deficiencies and offers a conceptual foundation for improving chronic illness care. The model identifies six elements of a delivery system that lead to improved care for individuals with chronic conditions (Glasgow et al., 2001; Wagner, 2002; Wagner et al., 2001):

- the community,
- the health system,
- self-management support,

- delivery system design,
- decision support, and
- clinical information systems.

Figure 2-1
Chronic care model



SOURCE: Wagner (1998). Reprinted with permission.

According to the model, patients are better able to actively take part in their own care and interact productively with providers when these components are developed, leading to improved functional and clinical outcomes.

Disease management and case management—The two most common approaches to coordinating care for people with chronic conditions are disease management and intensive case management programs (Medicare Payment Advisory Commission [MedPAC], 2004). Disease management programs teach patients to manage their chronic conditions and are often provided on a broader scale than case management programs. Services provided under a disease management program may include health promotion activities, patient education, use of clinical practice guidelines, telephone monitoring, use of home monitoring equipment, registries for providers, and access to drugs and treatments. Most disease management programs target persons with specific medical conditions but then take the responsibility for managing all of their additional chronic conditions. Case management programs typically involve fewer people than disease management programs (Vladek, 2001). Case management programs also tend to be more intensive and individualized, requiring the coordination of both medical and social support services for high-risk individuals. Typically, disease management programs are used with intensive case management for high-risk individuals who have multiple chronic conditions and complex medical management situations.

The empirical research on the effectiveness of disease management and case management approaches is mixed. Some studies have shown support for the clinical improvements and cost-effectiveness of disease management programs (Lorig, 1999; Norris et al., 2002; Plocher and Wilson, 2002; Centers for Disease Control and Prevention [CDC], 2002). Other programs, such as the CMS case management demonstration programs in the early 1990s, which required physician consent for patient participation, resulted in increased beneficiary satisfaction but failed to achieve any improvement in health outcomes, patient self-care management, or cost savings (Schore, Brown, and Cheh, 1999). In 2002, CMS selected 15 demonstration programs of varying sizes and intervention strategies as part of the Medicare Coordinated Care Demonstration (MCCD). None of the 15 programs produced any statistical savings in Medicare outlays on services relative to the comparison group, and two had higher costs (Peikes et al., 2009).[2] There were a few, scattered quality of care improvement effects. Two programs did show some promise in reducing hospitalizations and costs, suggesting that care coordination might at least be cost neutral. A major reason given for the lack of success in both Medicare savings and better health outcomes is attributed to the absence of a true transitional care model in which patients were enrolled during their hospitalizations. Studies have shown that approach to significantly reduce admissions within 30/60 days post-discharge, when patients are at high risk of being readmitted (Coleman et al., 2006; Naylor et al., 1999; Rich et al., 1995).

2.1.3 Conceptual Framework and CMHCB Demonstration Approaches

The care management organizations (CMOs) awarded contracts under this CMS initiative offered approaches that blend features of the chronic care management, disease management, and case management models. Their approaches relied, albeit to varying degrees, on engaging both physicians and beneficiaries and supporting the care processes with additional systems and staff. They proposed to improve chronic illness care by providing the resources and support directly to beneficiaries through their relationships with insurers, physicians, and communities in their efforts. The CMOs also planned to use all available information about beneficiaries to tailor their interventions across the spectrum of diseases that the participants exhibited.

Although each of the CMOs has unique program characteristics, all have some common features. These features include educating beneficiaries and their families on improving self-management skills, teaching beneficiaries how to respond to adverse symptoms and problems, providing care plans and goals, ongoing monitoring of beneficiary health status and progress, and providing a range of resources and support for self-management. Features of the CMHCB programs include:

- *Individualized assessment*. Several CMOs use proprietary algorithms to calculate a risk score or risk scores, while others depend on judgment of clinical staff. The scores are used to customize interventions to the participants' needs.

- *Education and skills*. A key step in improving self-management is educating beneficiaries and their families about their illnesses, how to react to symptoms, and

[2] These findings were based on regressions controlling for age, gender, race, disabled/aged entitlement, Medicaid coverage, and whether beneficiaries used skilled nursing facility (SNF) or hospital services prior to the demonstration.

what lifestyle changes to make. All of the CMOs provide a range of educational resources.

- *Medication management and support.* All of the CMO programs include efforts to optimize the medication regimens of participating beneficiaries. Some monitor compliance, some facilitate access to low-cost pharmaceuticals, and others offer face-to-face meetings with pharmacists.

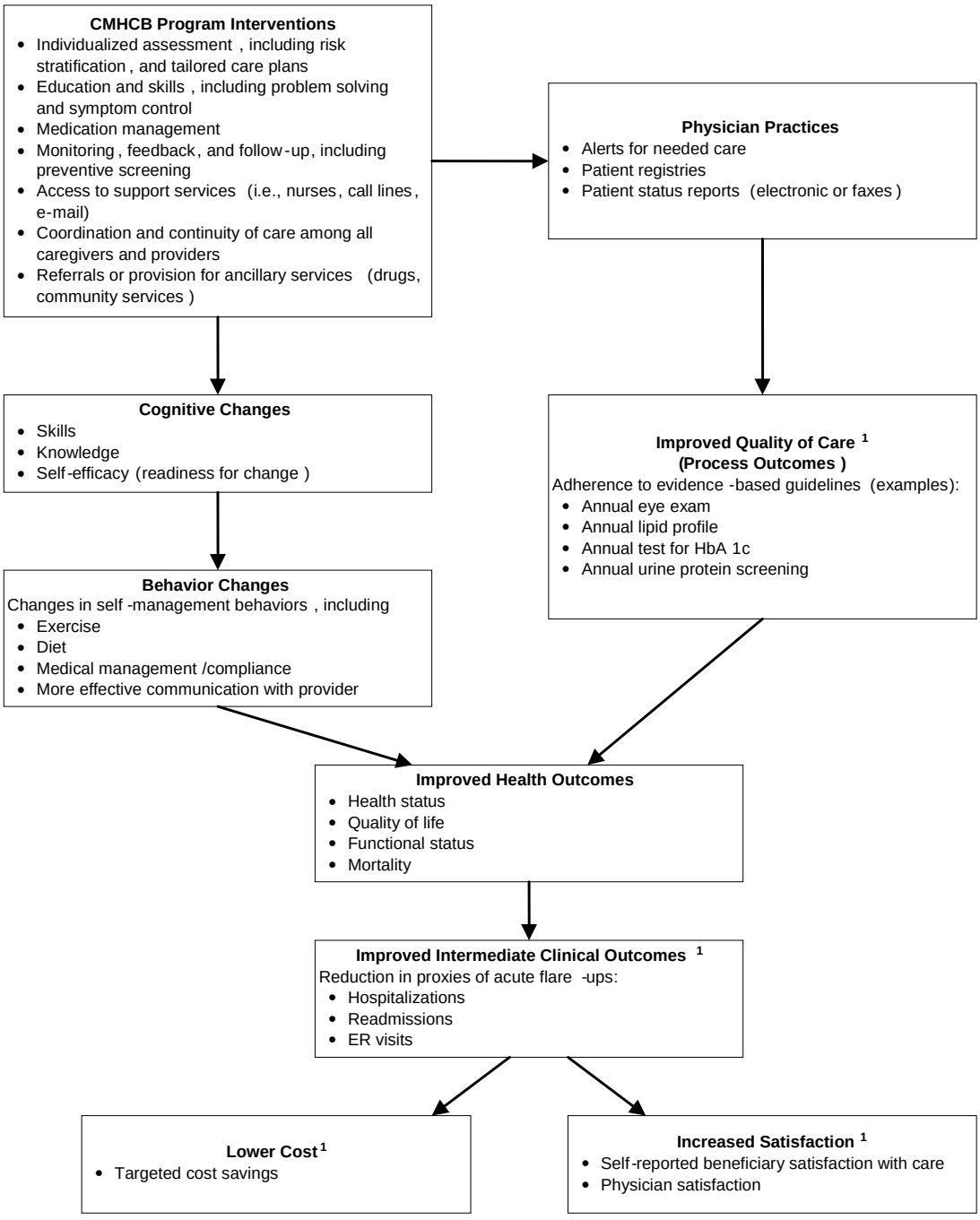
- *Monitoring, feedback, and follow-up*. Activities in this domain include ongoing biomonitoring of beneficiaries by placing scales or other equipment in their homes or by having the beneficiaries self-report their weights, blood sugars, or other measures. When data on preventive services, screenings, or recommended tests are available, the programs remind beneficiaries and/or their doctors to have them done. Flu shots are just one example.

- *Coordination and continuity of care.* One hallmark of the care management model is that it uses data from all available sources to disseminate information to providers and caregivers involved with a beneficiary's care. A limited number of the CMOs have care managers directly embedded in the physician practices, allowing for day-to-day and face-to-face interactions. Several CMOs also have direct communication with physicians via a shared electronic medical record. However, the majority of CMOs must engage physicians or physician practices more indirectly through telephone and fax communication.

- *Referrals or provision for community-based ancillary services.* Not all of a participant's needs are provided directly by the CMOs. All CMOs have recognized the need for transportation, low-cost prescriptions, or other services typically provided by community service organizations (e.g., social workers, dieticians). The CMOs developed relationships with other service providers and programs and helped selected beneficiaries receive these services through their participation in the CMHCB program.

Figure 2-2 presents RTI's conceptual framework for the overall CMHCB demonstration evaluation. It synthesizes the common features of the CMHCB demonstration implemented interventions and the broad areas of assessment within our evaluation design. The CMHCB demonstration programs employ strategies to improve quality of care while reducing costs by empowering Medicare beneficiaries to better manage their care. The programs do so in three ways: (1) by enhancing beneficiaries' knowledge of their chronic condition through educational and coaching interventions, (2) by improving beneficiaries' communication with their care providers, and (3) by improving beneficiaries' self-management skills. Successful interventions should alter beneficiaries' use of medications, eating habits, and exercise and should allow beneficiaries to interact more effectively with their primary health care providers. All of the CMHCB demonstration programs hypothesized that lifestyle changes and better communication with providers as well as improved adherence to evidence-based quality of care should improve health and functional status, which will mitigate acute flare-ups in chronic conditions, thereby reducing hospital admissions and readmissions and the use of other costly health services such as emergency rooms and visits to specialists. Experiencing better health and less acute care

Figure 2-2
Conceptual framework for the CMHCB programs



NOTE: CMHCB = Care Management for High Cost Beneficiaries; CMO = Care Management Organization; ER = emergency room.

SOURCE: RTI conceptual framework for the Medicare Care Management for High Cost Beneficiaries evaluation. Portions of this model are adapted from other sources, including the Chronic Care Model and the disease management model described in CBO (2004).

utilization, beneficiaries should also be more satisfied that their health care providers are effectively helping them cope with their chronic medical conditions, and providers should be more satisfied with the outcomes of care for their chronically ill Medicare FFS beneficiaries.

In this report, we present our findings with respect to the degree to which the Phase II Health Buddy® Program at Montefiore Demonstration was able to engage its intervention population and achieve four outcomes. ***Table 2-1*** presents a summary of research questions and data sources, organized by three evaluation domains: Reach, Implementation, and Effectiveness. The Phase II Health Buddy® Program at Montefiore Demonstration implementation experience is reported in Chapter 1.

Table 2-1
Evaluation research questions and data sources

Research questions	Site visits	CMO data	Claims	Survey
IMPLEMENTATION: To what extent was Robert Bosch Healthcare Systems, Inc. able to implement its Phase II Health Buddy® Program at Montefiore?	Yes	Yes	No	No
1. To what extent were specific program features implemented as planned? What changes were made to make implementation more effective? How was implementation related to organizational characteristics of the Phase II Health Buddy® Program at Montefiore?				
2. What were the roles of physicians, the community, the family, and other clinical caregivers? What was learned about how to provide this support effectively?	Yes	No	No	No
3. To what extent did the Phase II Health Buddy® Program at Montefiore engage physicians and physician practices in their programs?	Yes	No	No	No
REACH: How well did the Phase II Health Buddy® Program at Montefiore engage its intended audiences?				
1. Were there systematic baseline differences in demographic characteristics and disease burden between the intervention and comparison group beneficiaries at the start of the demonstration?	No	No	Yes	No
2. How many individuals were engaged and what were the characteristics of the participants versus nonparticipants (in terms of baseline clinical measures, demographics, and health status)?	No	Yes	Yes	No
3. What beneficiary characteristics predict participation?	No	Yes	Yes	No
4. To what extent were the intended audiences exposed to programmatic interventions? To what extent did participants engage in the various features of the program?	No	Yes	No	Yes
5. What beneficiary characteristics predict a high level of intervention versus a low level of intervention?	No	Yes	Yes	No

(continued)

Table 2-1 (continued)
Evaluation research questions and data sources

Research questions	Site visits	CMO data	Claims
EFFECTIVENESS: To what degree was the Phase II Health Buddy® Program at Montefiore able to improve clinical quality and health outcomes, and achieve targeted cost savings?			
Quality of care, health outcomes, and utilization			
1. Did the Phase II Health Buddy® Program at Montefiore improve quality of care, as measured by improvement in the rates of beneficiaries receiving guideline concordant care?	No	No	Yes
2. Did the Phase II Health Buddy® Program at Montefiore improve intermediate health outcomes by reducing acute hospitalizations, readmissions, and ER utilization?	No	No	Yes
3. Did the Phase II Health Buddy® Program at Montefiore improve health outcomes by decreasing mortality?	No	No	Yes
Financial outcomes			
1. What were the Medicare costs per beneficiary per month (PBPM) in the base year versus the 25 months of Phase I Original and Refresh months or 19 months of Phase II population demonstration for the intervention and the comparison groups?	No	No	Yes
2. What were the levels and trends in PBPM costs for intervention group participants and nonparticipants? Did nonparticipation, alone, materially reduce the intervention's overall cost savings?	No	No	Yes
3. How variable were PBPM costs in this high cost, high risk, population? What was the minimal detectable savings rate given the variability in beneficiary PBPM costs?	No	No	Yes
4. How did Medicare savings for the 25- or 19-month period compare with the fees that were paid out? How close was the Phase II Health Buddy® Program at Montefiore in meeting budget neutrality?	No	No	Yes
6. Did the intervention have a differential effect on high cost and high risk beneficiaries?	No	No	Yes

NOTE: CMO = care management organization; CMS = Centers for Medicare & Medicaid Services; CMHCB = Care Management for High Cost Beneficiaries; ER = emergency room; PBPM = per beneficiary per month.

2.1.4 General Analytic Approach

The CMHCB initiative is what is commonly called a "community intervention trial" (Piantadosi, 1997). It is a "community" in the sense of being population based for a prespecified geographic area. It is "experimental" because it tests different CMHCB program interventions in different areas. It is a "trial" that employs randomization (or selection of a comparison population) following an "intent-to-treat" (ITT) model. The initiative is unusual because it employs a "pre-randomized" scheme, wherein CMS assigns eligible beneficiaries to an intervention or comparison stratum before gaining their consent to participate. In fact, comparison beneficiaries are not contacted at all. Further, beneficiaries opting out of the intervention are assigned to the intervention group, even though they will receive no CMO

services. These refusals are included in the same stratum as those receiving care coordination services on an ITT basis.

Beneficiaries who become ineligible during the Phase II Demonstration program are removed from the intervention and comparison groups for the remainder of the demonstration for purposes of assessing cost savings and quality, outcomes, and satisfaction improvement. Our evaluation includes only months in which a beneficiary is eligible for the initiative, up until they become ineligible for any reason. We accounted for differential periods of eligibility in the analysis.

Further, the CMOs differentially engaged and interacted more with beneficiaries for whom they believe their programs will result in the greatest benefit, either in terms of health outcomes or cost savings. Thus, not all intervention beneficiaries participated nor did all beneficiaries receive the same level of intervention. In fact, some participants received very few services.

The CMHCB programs reflect a dynamic process of system change leading to behavioral change leading to improved clinical outcomes, and the type of experimental design within this demonstration calls for a pre/post, intervention/comparison analytic approach—sometimes referred to as a difference-in-differences approach—to provide maximum analytic flexibility. The strategy will be used to construct estimates of all performance outcomes of each demonstration program.

Our proposed model specification to explain any particular outcome variable, Y_{t+1}, measured during the intervention program follow-up period:

$$Y_{t+1} = \alpha + \beta_1 I + \beta_2 Y_t + \beta_3 I \bullet Y_t + \beta_4 X + \varepsilon \tag{2.1}$$

where

α = the intercept term, or reference group;

I = 0,1 intervention indicator;

Y_t = the outcome measured during a base or predemonstration period;

X = a vector of beneficiary covariates; and

ε = a regression error term.

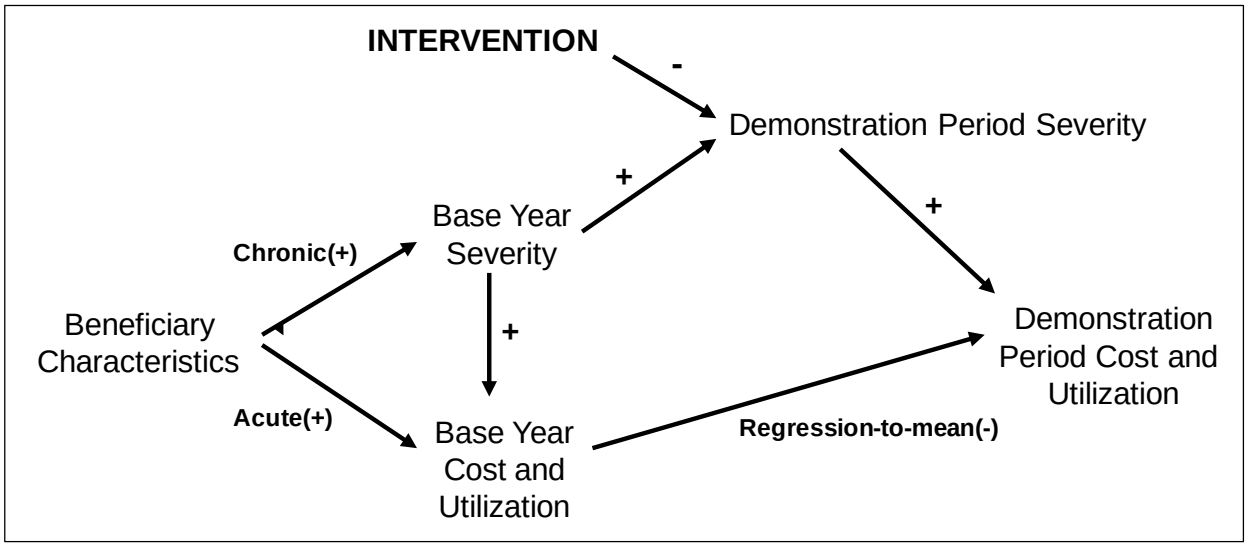
This model uses three sets of variables in analysis of covariance (ANCOVA) format to capture differences between intervention and comparison beneficiaries. The β_1 coefficient provides a test of the difference between the intervention group and comparison group in the base period for a particular outcome variable. (The reference comparison group mean value is in the α intercept.) If preprogram random assignment is successful, β_1 will be approximately zero before controlling for beneficiary-specific (X) factors. The β_2 coefficient tests for temporal changes between pre- and post-demonstration outcomes, while the β_3 interaction coefficient tests whether the intervention group's performance profile differs over time from the comparison

group's performance. The vector of β_4 coefficients controls for beneficiary-specific covariates influencing individual differences in the dependent variable of interest. Including covariates should set the estimated β_1 equal to 0, if selection of a comparable comparison population is contravened in some way. Program effects during the demonstration are reflected in the interaction coefficients. The null hypothesis is that the coefficient for β_3 is zero, implying no CMHCB program impact. Estimates that are significant at the 95% confidence level imply distinct program effects. The model may also be expanded to conduct analyses across beneficiary subpopulations and CMHCB intervention characteristics.

Because we will be analyzing change over time, it is important to consider the likely trajectory in our outcome measures as a function of beneficiary characteristics at baseline. ***Figure 2-3*** displays an alternative conceptualization of how the CMHCB intervention could alter the expected demonstration period outcomes of interest. At baseline, beneficiaries were selected for the demonstration because of higher baseline risk scores as well as high baseline expenditures as a proxy for clinical severity. These beneficiaries also have a multiplicity of other health care issues—chronic and acute—leading to high baseline costs and acute care utilization. The bottom half of ***Figure 2-3*** displays the statistical phenomenon observed in cohort studies of regression-to-the-mean. Beneficiaries with high costs and utilization are likely to regress toward average levels in a subsequent period and vice versa. Because we start with beneficiaries with high costs and utilization, our expectation is that there would be significant negative regression to the mean; thus, we would observe lower costs and utilization in the demonstration period absent an intervention effect.

Prior research has shown that physical health status declines rather substantially over time for elderly populations, and in particular, for chronically ill elderly populations (Ware 1996). The top half of ***Figure 2-3*** displays the expected positive relationship between base year and demonstration period severity and the positive relationship between increasing severity of illness and medical costs and utilization during the demonstration period absent an intervention effect. The Phase II CMHCB Demonstration is aimed at improving or preventing further deterioration in health and functional status. Thus, our expectation is that the Phase II CMHCB Demonstration intervention would have a negative or moderating influence on growing patient severity during the demonstration period, thereby reducing the expected positive relationship between demonstration period severity and costs and utilization.

Figure 2-3
Conceptualization of influence of beneficiary baseline health status and cost and utilization patterns on Phase II CMHCB Demonstration acute care utilization and costs



2.2 Participation, Clinical Quality and Health Outcomes, and Financial Outcomes Data and Analytic Variables

This section provides a description of the data used to evaluate participation in and the effectiveness of the Phase II Health Buddy® Program at Montefiore Demonstration.

2.2.1 Data

We used six types of data for our evaluation analyses related to participation, clinical quality and health outcomes, and financial outcomes. Specifically, we used the following data sources:

- *Participant status files*. We received participant status files from ARC. The participant status information originates from the Phase II Health Buddy® Program at Montefiore and was submitted to ARC. This file was updated quarterly and logged status changes within the intervention group. Participation status was able to be determined on a monthly basis using three monthly indicators on a given quarterly file, and we used these indicators to determine the participation decision of the original and refresh intervention beneficiaries during each month of the demonstration.

- *Finder file*. RTI used this file, produced by ARC, to identify the group into which each Phase II Health Buddy® Program at Montefiore Demonstration beneficiary was assigned—intervention or comparison—for both the Phase I Original and Refresh populations and Phase II population.

- *Enrollment Data Base (EDB) daily eligibility files.*

  — ARC provided RTI with an EDB file for the Phase II Health Buddy® Program at Montefiore Demonstration comprised of all assigned Phase I Original and Refresh beneficiaries that were eligible for the extended evaluation and all the assigned Phase II population beneficiaries. RTI used this file to determine daily eligibility based on the Phase II Health Buddy® Program at Montefiore Demonstration eligibility criteria (***Table 2-2***). The EDB file, in conjunction with the eligibility criteria, allowed us to identify beneficiaries as eligible or ineligible for each day of the intervention period and retrospectively for each day one-year prior to the Phase II Health Buddy® Program at Montefiore Demonstration launch date. We used the files to identify days of eligibility during the 12-month baseline period and the intervention periods of the demonstration and to select claims data during periods of eligibility in both the baseline and intervention periods. *Only beneficiaries who had at least 1 day of eligibility in the baseline period and at least 3 months of eligibility during the Phase II demonstration period are included in our evaluation*.

  — RTI conducted an EDB extract to obtain demographic characteristics at the time of Phase II eligibility determination by ARC (May 11, 2009) for the Phase I Original and Refresh populations.

  — RTI conducted an EDB extract to obtain demographic characteristics at the time of assignment (September 22, 2009) for the Phase II population.

- *Medicare claims data produced by ARC*. In keeping with the financial reconciliation, CMS requested that RTI use the ARC claims files for all analyses. Monthly, ARC receives claims data from a CMS prospective claims tap, and on a quarterly basis creates netted claims files. As of each quarter's processing, ARC updates prior quarterly netted claims files with claims data processed after the prior cutoff dates. These files contain the claims experience for Phase I Original and Refresh and Phase II population intervention and comparison beneficiaries during the 12 months prior to the Phase II Health Buddy® Program at Montefiore Demonstration start dates and claims with processing dates that span the full intervention period and 9 months thereafter (or claims run out).

- *CMO beneficiary intervention data files*. The Health Buddy® Program at Montefiore uses a health monitoring device that collects qualitative and quantitative information from patients on a daily basis. The intervention data files provided to us only collect information from patients that use the device. Quarterly, the Health Buddy® Program at Montefiore sent RTI beneficiary-level intervention files that contained summary counts of intervention activities, such as the number of surveys completed, counts of the number of inbound calls to a care manager from a patient and outbound calls to a patient from a care manager, as well as counts of calls between care managers and doctors regarding the patient. Information about high risk responses was also collected. More detailed information on the contents of these files is in ***Chapter 3***.

- *FU Long Term Indicator (LTI) file*. Information in this file is obtained from the Minimum Data Set (MDS) of nursing home assessments and contains data on which Medicare beneficiaries are residents of nursing homes. We use this file to determine institutionalization status during the Phase II intervention periods for the participation analysis.

Table 2-2
Criteria used for determining daily eligibility during the Phase II Health Buddy® Program at Montefiore CMHCB Demonstration

Ineligibility reasons	Description
Death	Ineligible beginning on day following date of death.
Hospice	Ineligible on hospice coverage start date.
ESRD	Ineligible beginning on day of ESRD enrollment.
MA plan	Ineligible on day of MA plan enrollment when GHO contract number does not equal the contract number for the Phase II Health Buddy® Program at Montefiore Demonstration.
Medicare secondary payer	Eligible on day following Medicare secondary payer end date. Ineligible on day Medicare becomes secondary payer for working-aged beneficiary with an employer group health plan (primary payer code A) or for working disabled beneficiary (primary payer code G).
Residence	Ineligible on residence change date indicating that a beneficiary has moved out of the service area determined by state code or state and county codes.
Part A/Part B enrollment	Ineligible on day after Part A/Part B coverage ends.

NOTES: CMHCB = Care Management for High Cost Beneficiaries; ESRD = end-stage renal disease; MA = Medicare Advantage; GHO = Group Health Organization.

Table 2-3 contains the Phase II Health Buddy® Program at Montefiore Demonstration's evaluation start and end dates, both baseline and intervention periods, for the Phase I Original and Refresh populations and the Phase II population.

Table 2-3
Analysis periods used in the Phase II Health Buddy® Program at Montefiore CMHCB Demonstration analysis of performance

Intervention period start date	Intervention period final end date	Intervention period months of intervention data	Baseline period start date	Baseline period end date
Phase I Original and Refresh populations				
6/1/09	6/30/11	25	6/1/08	5/31/09
Phase II refresh population				
12/1/09	6/30/11	19	12/1/08	11/30/09

NOTES: CMHCB = Care Management for High Cost Beneficiaries.

2.2.2 Analytic Variables

To conduct our participation, clinical quality, utilization, health outcomes, and financial analyses, we constructed nine sets of analytic variables from the aforementioned files.

1. ***Demographic Characteristics and Eligibility***. For the Phase I Original and Refresh population, age, gender, race, and Medicare status (aged-in versus disabled) were obtained from the EDB and determined as of the date of ARC's Phase II eligibility determination for the financial reconciliation report (May 11, 2009). For Phase II, these variables were created using the date of assignment, September 22, 2009. Medicaid enrollment was determined at any time during the baseline period and was also determined using the EDB.

   Daily eligibility variables were used to create analytic variables representing the fraction of the Phase II baseline and demonstration periods that the intervention and comparison beneficiaries were CMHCB program eligible. These eligibility fractions were created based on the time period of the analysis. For example, the baseline eligibility fraction is constructed using the number of eligible days divided by 365. For the full intervention period, the denominator is adjusted based on the number of days that the Phase II Health Buddy® Program at Montefiore was active in the demonstration. The numerator is the number of days the beneficiary is eligible during that time period. The Phase I Original and Refresh populations participated in the Phase II demonstration for 25 months, so the number of days in the denominator for each Phase I Original and Refresh population beneficiary in the Phase II Demonstration is 760 (Phase II Health Buddy® Program at Montefiore end date minus Phase II Health Buddy® Program at Montefiore start date + 1). If a beneficiary died 420 days into the intervention period, the eligibility fraction for the participation

analysis would be 420 divided by 760, or 0.553. The Phase II population was active for 19 months, or 577 days.

2. ***Institutionalized Status.*** Three binary indicators of institutionalization were created for all beneficiaries:

   - Whether a beneficiary was in a nursing home for any one or more months of the initial 6 months of the demonstration period using the Long Term Indicator (LTI) file created by FU Associates. This measure of institutionalization is used in all but the financial analyses.

   - Whether a beneficiary had any baseline long-term-care (LTC) hospital costs in the baseline year. LTC hospitals are identified if the last four digits of the provider ID ranged from 2000 to 2299.

   - Whether a beneficiary had any baseline skilled nursing facility (SNF) costs.

3. ***Hierarchical Condition Category (HCC) Risk Score.*** A prospective HCC score for each beneficiary was calculated by RTI for a 12-month period prior to the *start* of the Phase II demonstration program using the 2006 CMS-HCC risk-adjustment payment model.

4. ***Health Status***. We constructed three sets of analytic variables to reflect health status prior to and during the demonstration:

   - *Charlson index.* We constructed the Charlson comorbidity index using claims data from the inpatient, outpatient, physician, and home health claims files. We created an index for the year prior to the start of the Phase II Health Buddy® Program at Montefiore Demonstration. ***Supplement 2A*** contains the SAS code used to create this index.

   - *Comorbid conditions.* RTI created indicators of frequently occurring comorbid conditions: heart failure; coronary artery disease; other respiratory disease; diabetes without complications; diabetes with complications; essential hypertension; valve disorders; cardiomyopathy; acute and chronic renal disease; renal failure; peripheral vascular disease; lipid metabolism disorders; cardiac dysrhythmias and conduction disorders; dementias; strokes; chest pain; urinary tract infection; anemia; malaise and fatigue (including chronic fatigue syndrome); dizziness, syncope, and convulsions; disorders of joint; and hypothyroidism. Beneficiaries were identified as having a comorbid condition if they had one inpatient claim with the clinical condition as the principal diagnosis or had two or more physician or outpatient department (OPD) claims for an Evaluation & Management (E&M) service (CPT codes 99201-99429) with an appropriate principal or secondary diagnosis. The physician and/or OPD claims had to have occurred on different days. The diagnosis codes used to identify these clinical conditions are in ***Supplement 2A***.

   - *Ambulatory Care Sensitive Conditions (ACSCs).* We constructed 34 variables to indicate the presence of an ACSC in the year prior to the demonstration and

during the demonstration, using the primary diagnosis on a claim. ACSCs include Acute renal failure, Altered mental status, Anemia, Angina, Asthma, Bacterial Pneumonia, C. Difficile, Cellulitis, Congestive heart failure, Constipation/fecal impaction/obstipation, Chronic Obstructive Pulmonary Disease (COPD) and Chronic bronchitis, Dehydration/volume depletion, Diabetes, Diarrhea and gastroenteritis, Falls and trauma, Hypertension, Hypoglycemia, Hypokalemia, Hyponatremia, Hypotension, Immunization/Preventable Conditions, Influenza, Ischemic Stroke, Nutritional deficiencies, Perforated or Bleeding Ulcer, Pyelonephritis, Ruptured Appendix, Seizures, Septicemia, Severe Ear, Nose, and Throat Infections, Skin ulcers, Tuberculosis, Urinary Tract Infection (UTI), Weight Loss/Failure to thrive. The diagnosis codes used to identify these conditions are found in ***Supplement 2A***.

5. ***Utilization***. We constructed three sets of utilization variables for this evaluation as proxies for intermediate clinical outcomes. These sets of variables were also constructed for the following principal diagnoses: all cause and the ACSCs, using the primary diagnosis (from the header portion of the claim) for claim types inpatient and outpatient:

   - the number of acute hospitalizations,
   - 90-day readmissions, and
   - emergency room visits, including observation bed stays.

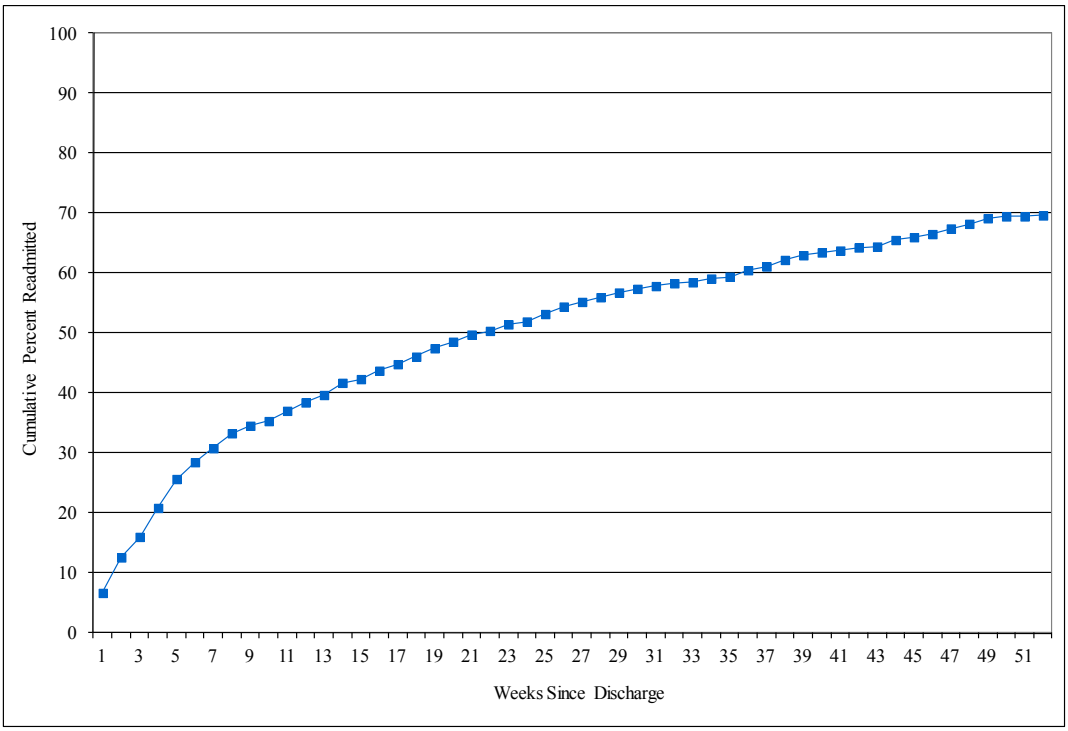
   Only claims that occurred during periods of eligibility were included in the utilization measures. For both the demonstration and baseline periods, claims were included if services were started during days that the beneficiary met the Phase II Health Buddy® Program at Montefiore Demonstration eligibility criteria, as determined from the ARC daily eligibility file. We flagged claims for services that occurred during a period of eligibility by comparing the eligibility period with a specific date on the claim, following the decision rules that were applied for the financial reconciliation. The exact date fields used are based on the claim type, as follows:

   - inpatient and skilled nursing facility claims: *admission date;*
   - all other types of services: *from date.*

   Prior to conducting our final set of analyses, we critically examined the timing of readmissions using data from the year prior to the start of the demonstration. ***Figure 2-4*** displays a graphic representation of time from discharge to next admission for Phase I Original population comparison beneficiaries who had a subsequent admission. In this figure, we display all-cause readmission; thus, beneficiaries were not required to have the same reason for both the initial and subsequent admission for the hospitalization to be considered a readmission. The graphic shows that there is a steep trajectory of readmissions during the first 90-day period following discharge, with a gradual tapering off of number of readmissions thereafter. Thus, we

constructed 90-day readmission rates to capture close to 40% of subsequent admissions in our analyses[3].

Figure 2-4
Percent with readmission for any diagnosis during the Phase II Health Buddy® Program at Montefiore CMHCB Demonstration: Phase I Original baseline comparison population



We examined readmissions following admissions that occurred during the last 12 months for the Phase I Original and Refresh populations and the Phase II population. In order to capture readmissions following admissions that occurred late in the baseline and demonstration periods, we used a total of 15 months of data for each period to identify readmissions. For the baseline period, we identified admissions during the 12 months preceding the start of the Phase II demonstration and also included readmissions through the first 3 months of the intervention period for those admissions that occurred within 3 months of the start of the demonstration. The intervention period for the Phase I Original and Refresh populations examined admissions during the periods of months 11 through 22 and included readmissions through month 25 and the Phase II population examined admissions during months 5 through 16 and included readmissions through month 19. A readmission was defined as an admission up to 90 days after an index hospitalization discharge date. We

[3] We evaluated time to readmission based upon days post sentinel hospitalization discharge; however, the graph displays time to readmission in increments of weeks for visual presentation purpose.

constructed all-cause readmission rates for all hospitalizations and same-cause readmission rates for the ACSCs.

6. ***Expenditures***. RTI constructed a set of Medicare payment variables to reflect payments during periods of baseline and demonstration eligibility using the claims selection decision rules discussed previously. Total Medicare payments—exclusive of beneficiary deductibles, coinsurance payments, and third-party payments—were summarized for the annual period prior to the start date of Phase II and also for the full intervention period and placed on a per beneficiary per month (PBPM) basis by dividing total payments by the total number of eligible days divided by 30.42. We defined a month as 30.42 days (365 days in a year divided by 12 months, rounded to two decimal places). This standardizes the definition of a month. For the Phase II Health Buddy® Program at Montefiore Demonstration period, total Medicare payments were summarized for the 25-month Phase I Original and Refresh population intervention period and the 19-month Phase II population intervention period.

7. ***Guideline Concordant Care***. We define quality of care as adherence to evidence-based guideline-concordant care and have selected measures from the National Quality Forum (NQF)-endorsed National Voluntary Consensus Standards for Physician-Focused Ambulatory Care (February 2008). The selected measures are also used by other CMS pay-for-performance initiatives, such as the PQRI, or in evaluations of other pay-for-performance demonstrations (physician group practice demonstration) or pilot programs (Medicare Health Support). Thus, these measures have been extensively tested and are widely accepted as clinically important measures and appropriate for use in pay-for-performance initiatives. Further, we restrict the selection of measures to those that do not require the use of CPT II codes.

   First, we selected several measures that are specific to beneficiaries with diabetes and ischemic vascular disease (IVD) as these populations are prevalent in the Medicare population. We subset the study populations to the appropriate clinical cohorts when constructing these measures.

   The selected measures and relevant disease population are as follows:

   - <u>Diabetes beneficiaries</u>:
     - Rate of annual HbA1c testing – diabetes
     - Rate of low-density lipoprotein cholesterol (LDL-C) screening – diabetes
     - Rate of annual retinal eye exam
     - Rate of medical attention for nephropathy
     - Rate at which beneficiaries received all four of these measures
     - Rate at which beneficiaries received none of these measures

- IVD beneficiaries:
  - Rate of complete lipid profile

The methodology used to create these measures can be found in ***Supplement 2A***. CMS requested that we use existing, widely adopted specifications for evidence-based measures of care. Based on that request, RTI selected the National Quality Forum (NQF)–endorsed National Voluntary Consensus Standards for Physician-Focused Ambulatory Care. While the NQF-endorsed specifications restrict the diabetes quality-of-care measures to beneficiaries ages 18 to 75, we did not use this age restriction because no such restriction is used by the Phase II Health Buddy® Program at Montefiore Demonstration. The specifications used for the final set of analyses are from NQF-Endorsed™ National Voluntary Consensus Standards for Physician-Focused Ambulatory Care—National Committee for Quality Assurance (NCQA) Measure Technical Specifications, 2011.

Claims for these process-of-care measures were included regardless of Phase II Health Buddy® Program at Montefiore Demonstration eligibility in order to ensure that we fully captured the behavior of intervention and comparison populations that was not subject to Medicare eligibility or payment rules and to provide credit to the Phase II Health Buddy® Program at Montefiore Demonstration in case the services occurred after exposure to the CMHCB demonstration intervention and during the intervention period. One could envision that the Phase II Health Buddy® Program at Montefiore Demonstration encouraged the receipt of the process-of-care measures; however, the actual service was provided during a brief period of ineligibility (e.g., nonpayment of the Part B premium for a month). To the extent that the service was included in the Medicare claims files during a period of ineligibility as a denied claim, it reflects actual receipt of the service and was therefore included in our analyses.

8. ***Mortality.*** Date of death during the demonstration period was obtained from the Medicare EDB and was used to create a binary mortality variable.
9. ***Measures of CMHCB Program Intervention***. Using the encounter data submitted by the Phase II Health Buddy® Program at Montefiore Demonstration, we constructed counts of the number of telephonic contacts with the participants (both inbound and outbound) and between caregivers—as well as total contacts (both), and number of surveys completed.

2.3 Baseline Comparison Analysis and Propensity Score Weighting

RTI conducted analyses to determine whether the intervention and comparison groups were equivalent at the start of the Phase II Health Buddy® Program at Montefiore Demonstration. Of particular concern was the comparability of the intervention and comparison groups for the Phase I Original and Refresh populations at the start of Phase II. The first step was to examine the first reason for ineligibility during the demonstration for beneficiaries that were eligible at the start of the Phase II demonstration period. Next, we evaluated baseline characteristics during the year prior to the start of Phase II (June 1, 2008 – May 31, 2009 for the

Phase I Original refresh populations and December 1, 2008 – November 30, 2009 for the Phase II population) for both the intervention and comparison populations. We evaluated baseline characteristics for all beneficiaries who were eligible on the first day of the Phase II demonstration and for beneficiaries who were eligible for at least 3 months during the Phase II demonstration period. We also evaluated comparability of the intervention and comparison groups after applying propensity score weights derived from observable data in the Medicare EDB or claims data files.

2.3.1 Initial Reason for Ineligibility

Table 2-4 displays the first reason a beneficiary became ineligible and, using the chi-square test, determines if these distributions differ between the intervention and comparison groups. For the Phase I Original population, the comparison group had a higher rate of ineligibility due to beneficiaries joining a managed care plan. There were no statistically significant differences in the initial reason for ineligibility between the intervention and comparison beneficiaries in the Phase I Refresh population. The Phase II population intervention beneficiaries had a 1.4 percentage point higher rate of beneficiaries that died relative to the comparison group (9.6% versus 8.2%). And, modestly more intervention beneficiaries moved out of the area (1.2% versus 0.6%).

Table 2-4
First reason for ineligibility in the Phase II Health Buddy® Program at Montefiore CMHCB Demonstration

Reasons for ineligibility	I	C	I %	C %	I-C	Likelihood ratio X^2	*p-value*
Phase I Original							
Number of beneficiaries eligible on 6/1/09	1,743	1,060	100.0	100.0	N/A	N/A	N/A
Died	296	174	17.0	16.4	0.6	0.15	0.70
ESRD	21	10	1.2	0.9	0.3	0.42	0.52
Joined MA Plan	62	86	3.6	8.1	-4.6	26.35	<.0001
Elected Hospice	74	42	4.2	4.0	0.3	0.13	0.71
Medicare Secondary Payer	1	.	0.1	0.0	0.1	0.95	0.33
Loss of Part A or Part B	6	3	0.3	0.3	0.1	0.08	0.78
Moved Out of Service Area	32	11	1.8	1.0	0.8	2.94	0.09
Number of beneficiaries eligible on 6/30/11	1,251	734	71.8	69.2	2.5	N/A	N/A

(continued)

Table 2-4 (continued)
First reason for ineligibility in the Phase II Health Buddy® Program at Montefiore CMHCB Demonstration

Reasons for ineligibility	I	C	I %	C %	I-C	Likelihood ratio X^2	*p-value*
Phase I Refresh							
Number of beneficiaries eligible on 6/1/09	671	612	100.0	100.0	N/A	N/A	N/A
Died	103	81	15.4	13.2	2.1	1.17	0.28
ESRD	2	7	0.3	1.1	-0.8	3.44	0.06
Joined MA Plan	35	43	5.2	7.0	-1.8	1.84	0.18
Elected Hospice	22	25	3.3	4.1	-0.8	0.59	0.44
Loss of Part A or Part B	3	3	0.4	0.5	0.0	0.01	0.91
Moved Out of Service Area	13	11	1.9	1.8	0.1	0.03	0.85
Number of beneficiaries eligible on 6/30/11	493	442	73.5	72.2	1.3	N/A	N/A
Phase II Population							
Number of beneficiaries eligible on 12/1/09	4,310	4,325	100.0	100.0	N/A	N/A	N/A
Died	415	354	9.6	8.2	1.4	5.55	0.02
ESRD	39	24	0.9	0.6	0.3	3.68	0.05
Joined MA Plan	239	259	5.5	6.0	-0.4	0.78	0.38
Elected Hospice	115	125	2.7	2.9	-0.2	0.39	0.53
Medicare Secondary Payer	1	5	0.0	0.1	-0.1	2.90	0.09
Loss of Part A or Part B	5	7	0.1	0.2	0.0	0.33	0.57
Moved Out of Service Area	75	50	1.7	1.2	0.6	5.20	0.02
Number of beneficiaries eligible on 6/30/11	3,421	3,501	79.4	80.9	-1.6	N/A	N/A

NOTES: CMHCB = Care Management for High Cost Beneficiaries; ESRD = end-stage renal disease; MA = Medicare Advantage.

2.3.2 Propensity Score Methodology

Propensity Score Methodology. While the Health Buddy® Program at Montefiore Demonstration and comparison areas were matched as closely as possible on the basis of ZIP code characteristics, this does not guarantee that key beneficiary characteristics will also be similar in each group. We conducted propensity score analyses for each cohort to assess group differences. A propensity score is the probability that a beneficiary is a member of the demonstration group. Propensity scores were estimated by logistic regression, regressing group status (1=demonstration group, 0=comparison group) on a set of beneficiary characteristics measured during the baseline period. These characteristics consisted of chronic disease status (HCC risk and Charlson morbidity scores, prior institutionalization), demographic characteristics

(age group, gender, race), Medicaid eligibility, disability status, and mean monthly Medicare expenditures.

Inverse Propensity Score Weighting. The models produce the predicted probability that a beneficiary was a member of the Health Buddy® Program at Montefiore Demonstration. These predicted propensity scores (PS) were then converted into weights for analysis purposes. The group-specific weights were:

PS weight = 1 for all beneficiaries in the Health Buddy® Program at Montefiore Demonstration ZIPs in a specified cohort, and

PS weight = PS/(1-PS) for comparison beneficiaries.

To account for periods of ineligibility for Medicare, eligibility fractions were also computed. The eligibility fraction is the proportion of the baseline year in which a beneficiary was eligible for both Medicare Parts A and B. Total weights were the product of the PS and eligibility values. Weighting helps to ensure that beneficiaries in each group are similar in terms of their pre-demonstration or baseline characteristics. As such, the effect of weighting is similar to the effect of randomization in experimental designs.

Propensity Model for Device Users. In addition to the model for demonstration group status, a separate propensity model was estimated for the probability of Health Buddy® device use aggregated across all three cohorts. The percentage of demonstration beneficiaries who reported using the Health Buddy® device for at least one quarter during the demonstration period was similar in each cohort, ranging from 21.3% of the Phase II group to 24.0% of those in the Phase I Refresh. These models were estimated using the same covariates described above, and inverse propensity weights were computed for device use.

Group Comparability. The primary objective of weighting is to increase the comparability of the demonstration and comparison groups prior to estimating the effects of the demonstration. Comparability is reflected by the extent to which covariate means are similar (or "balanced") between the two groups. We used the propensity score weights to evaluate the comparability issue by applying the weights to both groups, examining the weighted means, and assessing shifts between weighted and unweighted means in the comparison group. The results can also be displayed graphically in the form of "butterfly" graphs, stacked histograms that display the demonstration group means to the left and the corresponding comparison group results to the right.

2.4 Propensity Model Results

The results of the propensity models for group status were remarkably consistent across the three cohorts. In each one, the only variables with large propensity impacts were Medicaid status and white race ($p < 0.01$). White beneficiaries were significantly more likely reside in the Health Buddy® Program at Montefiore Demonstration ZIP codes, while Medicaid eligibles were less likely to be found in those ZIP codes. These effects were produced by differences in the sociodemographic composition of the demonstration and comparison ZIP codes. Despite these disparities, group status was not influenced by indicators of health such as overall risk scores,

comorbidity, or monthly Medicare expenditures. The models for individual cohorts exhibited relatively low levels of discrimination, with c-statistics ranging from only 0.594 to 0.697.

The pooled propensity model for Health Buddy® device use provides information about characteristics that are associated with a beneficiary's decision about whether to use the device. Race and Medicaid status were also influential in this model, reflecting the group differences noted above since all device users were from the demonstration group. However, the direction of the race effect was reversed in this model. Beneficiaries were less likely to use the device if they were white, Medicaid-eligible, older than 85 years, or had been institutionalized in the previous year. The results also indicated that beneficiaries from the first two cohorts were more likely to be users than those from the Phase II group after adjusting for other beneficiary characteristics.

2.5 Comparison of Beneficiary Characteristics

Detailed characteristics for beneficiaries at baseline are shown in ***Tables 2-5a through 2-5c*** for each cohort with separate columns for the demonstration and comparison groups. The characteristics include sample sizes, demographic characteristics, health status variables, utilization measures, total monthly Medicare expenditures during the baseline year, and the components of total expenditures. Differences between the groups were tested for statistical significance using t-tests. The table for each cohort is divided into three panels. The left panel shows results for the full cohorts weighted only by eligibility fraction (the proportion of the follow-up period that beneficiaries were eligible for both Medicare Parts A and B). The middle panel removes beneficiaries who had less than 3 months of eligibility. Members of the excluded group tended to have more extreme expenditure values because their means are based on only a few months of data. In all three cohorts, average expenditures were lower after eliminating beneficiaries with less than three months of experience. The right panel shows the results after adjustment by propensity weights.

Table 2-5a shows the data for the original Phase I beneficiaries. Of the 28 characteristics examined, more than half (17) yielded statistically significant differences at the 5% level. The largest differences were found for racial group (a much higher percentage of whites in the demonstration group) and Medicaid eligibility, which was more common in the comparison group. As noted earlier, this reflects disparities between the Medicare composition of the demonstration ZIP codes and the ZIP codes selected for comparison.

Removing beneficiaries with less than three months of eligibility (middle panel) decreased the total sample size by 99 beneficiaries. This reduced mean monthly Medicare expenditures by about $87 per beneficiary, but had little impact on the number of significantly different group differences.

Finally, the right panel shows the effects of applying propensity weights. The effects of weighting were striking, eliminating all of the previous group differences except for two cost components. Propensity weights achieve this effect by giving greater influence to comparison beneficiaries who are most similar to those in the demonstration group. The process is illustrated by the "butterfly" graph in ***Figure 2-5*** for some selected characteristics. The bars on the left side of the graph depict the demonstration group means. The bars to the right show the comparison

Table 2-5a

Characteristics of Medicare Fee-for-Service Beneficiaries assigned to the Intervention and Comparison Groups in the Phase II Health Buddy® Program at Montefiore CMHCB Demonstration: Characteristics assessed in the year prior to the start of Phase II for the Phase I Original Population

	Weighted by eligibility fraction				Dropping beneficiaries with less than 3 months of eligibility and weighted by eligibility fraction				Dropping beneficiaries with less than 3 months of eligibility and weighted by eligibility fraction and propensity score			
Characteristics	I	C	I-C	*p-value*[1]	I	C	I-C	*p-value*[1]	I	C	I-C	*p-value*[1]
Number of eligibles	1,743	1,060	N/A	N/A	1,691	1,013	N/A	N/A	1,691	1,013	N/A	N/A
Number of FTEs	1,732	1,044	N/A	N/A	1,682	998	N/A	N/A	1,682	998	N/A	N/A
Age	80.7	79.8	-0.95	**	80.7	79.7	-0.98	**	80.7	80.8	0.11	N/S
Age < 65	0.0	0.1	0.03	**	0.0	0.1	0.03	**	0.0	0.0	0.00	N/S
Age 65-74	16.8	20.4	3.61	*	17.1	20.2	3.17	*	17.1	17.9	0.85	N/S
Age 75-84	44.5	40.6	-3.94	*	44.0	41.1	-2.98	N/S	44.0	43.7	-0.31	N/S
Age 85+ years	34.8	31.8	-3.00	N/S	34.9	31.4	-3.45	N/S	34.9	33.9	-0.94	N/S
Female	61.8	67.3	5.57	**	61.5	67.5	6.06	**	61.5	62.5	1.00	N/S
White	68.5	40.5	-28.06	**	68.4	40.2	-28.15	**	68.4	68.4	0.00	N/S
Disabled	4.4	8.0	3.64	**	4.5	8.1	3.59	**	4.5	5.0	0.51	N/S
Medicaid	32.1	58.2	26.09	**	32.1	58.4	26.29	**	32.1	31.9	-0.16	N/S
Institutionalized	5.8	3.9	-1.90	*	5.7	3.7	-2.05	*	5.7	5.7	-0.01	N/S
Average HCC score	1.5	1.6	0.12	**	1.5	1.6	0.10	*	1.5	1.4	-0.03	N/S
Average Charlson Index	3.0	3.0	-0.01	N/S	2.9	2.9	-0.02	N/S	2.9	2.8	-0.13	N/S
Rate of all-cause hospitalizations	739	801	61	N/S	720	749	29	N/S	720	690	-31	N/S
Rate of ACSC hospitalizations	342	367	25	N/S	334	337	3	N/S	334	307	-27	N/S
Rate of all-cause emergency room visits	987	1,229	242	**	972	1,187	215	**	972	999	27	N/S
Rate of ACSC emergency room visits	366	495	129	**	361	470	109	**	361	401	40	N/S
Rate of all-cause 90-day readmissions	785	874	89	N/S	759	787	28	N/S	759	715	-44	N/S
Rate of ACSC 90-day readmissions	165	168	3	N/S	158	137	-21	N/S	158	105	-53	N/S
Average PBPM Medicare Expenditures												
Total	1,797	1,822	25	N/S	1,733	1,694	-39	N/S	1,733	1,632	-101	N/S
Long-term care	5	20	15	N/S	1	8	7	N/S	1	2	1	N/S
Rehabilitation	23	50	27	**	23	51	29	**	23	68	45	**
Psychiatric	3	7	3	N/S	3	7	4	N/S	3	5	1	N/S
Inpatient	799	885	86	N/S	762	790	28	N/S	762	716	-46	N/S
Home Health	127	168	41	**	125	162	37	**	125	141	16	N/S
DME	51	71	19	*	51	69	18	*	51	55	4	N/S
Physician	465	371	-94	**	453	363	-89	**	453	382	-71	**
Skilled Nursing Facility	196	126	-69	**	193	121	-72	**	193	145	-48	N/S
Hospital Outpatient	127	124	-3	N/S	124	123	-1	N/S	124	118	-5	N/S

Table 2-5b

Characteristics of Medicare Fee-for-Service Beneficiaries assigned to the Intervention and Comparison Groups in the Phase II Health Buddy® Program at Montefiore CMHCB Demonstration: Characteristics assessed in the year prior to the start of Phase II for the Phase I Refresh Population

	Weighted by eligibility fraction				Dropping beneficiaries with less than 3 months of eligibility and weighted by eligibility fraction				Dropping beneficiaries with less than 3 months of eligibility and weighted by eligibility fraction and propensity score			
Characteristics	I	C	I-C	*p-value*[1]	I	C	I-C	*p-value*[1]	I	C	I-C	*p-value*[1]
Number of eligibles	671	611	N/A	N/A	650	597	N/A	N/A	650	597	N/A	N/A
Number of FTEs	663	600	N/A	N/A	643	586	N/A	N/A	643	586	N/A	N/A
Age	78.0	78.8	0.80	N/S	78.0	78.8	0.85	N/S	78.0	78.3	0.29	N/S
Age < 65	0.1	0.1	-0.01	N/S	0.1	0.1	-0.01	N/S	0.1	0.1	0.01	N/S
Age 65-74	24.0	24.7	0.69	N/S	24.5	25.1	0.65	N/S	24.5	24.4	-0.13	N/S
Age 75-84	43.0	39.7	-3.37	N/S	43.1	39.4	-3.67	N/S	43.1	43.0	-0.09	N/S
Age 85+ years	24.9	28.3	3.42	N/S	24.5	28.3	3.86	N/S	24.5	24.2	-0.27	N/S
Female	63.9	68.7	4.81	N/S	64.1	68.6	4.52	N/S	64.1	64.7	0.56	N/S
White	60.8	42.9	-17.88	**	60.3	42.5	-17.75	**	60.3	61.1	0.78	N/S
Disabled	8.2	8.5	0.28	N/S	8.2	8.4	0.19	N/S	8.2	8.7	0.50	N/S
Medicaid	36.5	62.1	25.53	**	36.5	61.8	25.38	**	36.5	36.3	-0.21	N/S
Institutionalized	3.1	3.9	0.78	N/S	3.0	3.9	0.93	N/S	3.0	3.5	0.48	N/S
Average HCC score	1.4	1.6	0.20	**	1.4	1.6	0.21	**	1.4	1.4	0.04	N/S
Average Charlson Index	2.9	2.9	0.08	N/S	2.8	2.9	0.15	N/S	2.8	2.8	-0.02	N/S
Rate of all-cause hospitalizations	746	775	29	N/S	717	746	29	N/S	717	647	-71	N/S
Rate of ACSC hospitalizations	336	357	20	N/S	322	328	6	N/S	322	251	-71	N/S
Rate of all-cause emergency room visits	1,066	1,163	97	N/S	1,038	1,130	92	N/S	1,038	924	-114	N/S
Rate of ACSC emergency room visits	372	467	94	N/S	358	444	86	N/S	358	346	-11	N/S
Rate of all-cause 90-day readmissions	914	782	-132	N/S	879	746	-133	N/S	879	664	-215	N/S
Rate of ACSC 90-day readmissions	146	117	-29	N/S	158	88	-70	N/S	158	59	-99	N/S
Average PBPM Medicare Expenditures												
Total	1,811	1,876	65	N/S	1,772	1,821	49	N/S	1,772	1,748	-24	N/S
Long-term care	8	0	-8	N/S	8	0	-8	N/S	8	0	-8	N/S
Rehabilitation	20	33	12	N/S	16	31	14	N/S	16	38	21	N/S
Psychiatric	1	4	3	N/S	1	4	3	N/S	1	3	2	N/S
Inpatient	842	929	87	N/S	820	897	77	N/S	820	839	19	N/S
Home Health	110	160	50	**	108	151	43	**	108	135	27	N/S
DME	37	67	30	**	37	66	29	**	37	57	20	*
Physician	478	379	-99	**	472	373	-99	**	472	378	-94	**
Skilled Nursing Facility	180	119	-61	N/S	176	114	-62	N/S	176	103	-73	*
Hospital Outpatient	134	186	51	N/S	133	186	53	N/S	133	195	62	N/S

Table 2-5c

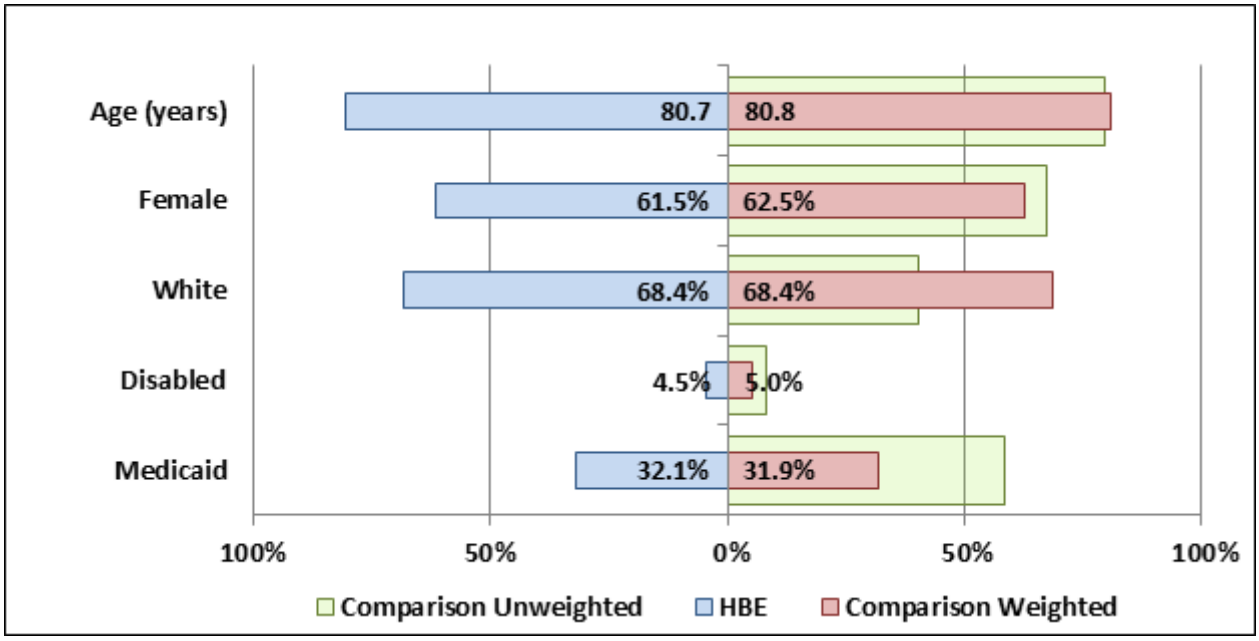
Characteristics of Medicare Fee-for-Service Beneficiaries assigned to the Intervention and Comparison Groups in the Phase II Health Buddy® Program at Montefiore CMHCB Demonstration: Characteristics assessed in the year prior to the start of Phase II for the Phase II Population

	Weighted by eligibility fraction				Dropping beneficiaries with less than 3 months of eligibility and weighted by eligibility fraction				Dropping beneficiaries with less than 3 months of eligibility and weighted by eligibility fraction and propensity score			
Characteristics	I	C	I-C	*p-value*[1]	I	C	I-C	*p-value*[1]	I	C	I-C	*p-value*[1]
Number of eligibles	4,310	4,325	N/A	N/A	4,127	4,188	N/A	N/A	4,127	4,188	N/A	N/A
Number of FTEs	4,267	4,291	N/A	N/A	4,088	4,158	N/A	N/A	4,088	4,158	N/A	N/A
Age	76.4	76.5	0.03	N/S	76.4	76.5	0.08	N/S	76.4	76.4	0.05	N/S
Age < 65	0.1	0.1	0.00	N/S	0.1	0.1	0.00	N/S	0.1	0.1	0.00	N/S
Age 65-74	30.9	29.8	-1.12	N/S	30.9	29.9	-0.94	N/S	30.9	30.3	-0.57	N/S
Age 75-84	37.5	38.5	1.07	N/S	37.7	38.6	0.89	N/S	37.7	38.1	0.39	N/S
Age 85+ years	21.8	21.8	0.02	N/S	21.5	21.7	0.13	N/S	21.5	21.6	0.04	N/S
Female	64.8	65.0	0.20	N/S	65.1	65.3	0.20	N/S	65.1	65.3	0.17	N/S
White	55.3	48.7	-6.58	**	55.2	48.8	-6.31	**	55.2	55.3	0.12	N/S
Disabled	10.8	10.7	-0.08	N/S	10.9	10.7	-0.20	N/S	10.9	11.0	0.15	N/S
Medicaid	40.1	56.3	16.24	**	40.1	56.2	16.14	**	40.1	40.1	0.04	N/S
Institutionalized	1.9	1.1	-0.81	**	1.9	1.1	-0.81	**	1.9	1.9	-0.01	N/S
Average HCC score	2.2	2.2	0.02	N/S	2.2	2.2	0.03	N/S	2.2	2.2	0.02	N/S
Average Charlson Index	3.2	3.2	0.02	N/S	3.1	3.1	0.02	N/S	3.1	3.2	0.04	N/S
Rate of all-cause hospitalizations	848	797	-51	N/S	807	772	-35	N/S	807	768	-38	N/S
Rate of ACSC hospitalizations	370	309	-62	**	347	300	-47	**	347	297	-50	**
Rate of all-cause emergency room visits	1,137	1,072	-65	N/S	1,100	1,048	-52	N/S	1,100	1,011	-89	*
Rate of ACSC emergency room visits	409	375	-34	N/S	388	367	-21	N/S	388	353	-35	N/S
Rate of all-cause 90-day readmissions	773	742	-31	N/S	733	720	-13	N/S	733	714	-19	N/S
Rate of ACSC 90-day readmissions	175	138	-37	N/S	176	138	-38	N/S	176	137	-39	N/S
Average PBPM Medicare Expenditures												
Total	2,087	2,036	-51	N/S	1,996	1,977	-19	N/S	1,996	2,055	59	N/S
Long-term care	7	13	6	N/S	4	12	8	N/S	4	16	12	N/S
Rehabilitation	36	71	34	**	35	71	36	**	35	78	42	**
Psychiatric	2	2	0	N/S	2	2	0	N/S	2	2	0	N/S
Inpatient	1,034	993	-41	N/S	976	955	-21	N/S	976	983	7	N/S
Home Health	126	129	3	N/S	122	126	4	N/S	122	125	3	N/S
DME	43	46	3	N/S	42	46	4	N/S	42	45	3	N/S
Physician	491	465	-26	*	482	462	-20	N/S	482	479	-3	N/S
Skilled Nursing Facility	153	97	-56	**	145	93	-51	**	145	114	-31	*
Hospital Outpatient	195	219	24	*	188	210	22	N/S	188	213	24	*

NOTES: CMHCB = Care Management for High Cost Beneficiaries; FTE = full-time equivalents; HCC = Hierarchical Condition Category (HCC) Risk Scores; ACSC = Ambulatory Care Sensitive Conditions; PBPM = per beneficiary per month; DME = durable medical equipment.
N/A means not applicable; N/S means not statistically significant
[1] * denotes statistical significance at the 5% level;** denotes statistical significance at the 1% level.
Data Sources: RTI analysis of 2008-2011 Medicare enrollment, eligibility, claims and encounter data.
SOURCE: table3-1.xls, table3-1c.xls, table3-1final.xls

group means before and after propensity weighting. For each characteristic, weighting draws the comparison mean closer to the demonstration group mean. The shifts are especially pronounced for the proportions of white and Medicaid beneficiaries. Balance in mean values is nearly always achieved for characteristics, like the demographic factors, that are employed as covariates in the propensity model. However, balancing also extends to variables that are not covariates as well. An example of this is the total ER visit rates, which were no longer statistically different after propensity adjustment. The propensity weights were used in subsequent multivariate outcome analyses to reduce potential bias when estimating the effects of the demonstration.

Figure 2-5
Group means for Health Buddy® Program at Montefiore Demonstration Phase I Original Population, unweighted comparisons, and propensity-weighted comparisons



NOTES: HBE = Health Buddy® Program at Montefiore Demonstration

Tables 2-5b and 2-5c display the group comparisons for the Phase I Refresh and Phase II populations, respectively, at baseline. These two populations had fewer unadjusted group differences than the original Phase I Population. The Phase II sample appears to be less healthy than the others based on their higher HCC risk scores and Medicare expenditure levels. Otherwise, the patterns for these two populations were similar to those for the original population: 1) eligibility exclusions reduced sample sizes by less than 3%, 2) the largest difference were for the prevalence of white and Medicaid beneficiaries, 3) excluding those with less than 3 months of eligibility did not alter the number of significant group differences, 4) mean monthly expenditures were lower after eligibility exclusions, and 5) propensity-weighting eliminated all but a few group differences for cost components. Two minor utilization-related differences persisted after adjustment in the Phase II sample, but the large sample size for this phase produces statistically significant results for small absolute differences.

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CHAPTER 3
PARTICIPATION RATES IN THE PHASE II HEALTH BUDDY® PROGRAM AT MONTEFIORE CMHCB DEMONSTRATION AND LEVEL OF INTERVENTION

3.1 Introduction

Our participation analysis is designed to critically evaluate the level of engagement by the Health Buddy® Program at Montefiore in this population-based demonstration program and to identify any characteristics that systematically predict participation versus nonparticipation. Furthermore, we seek to evaluate the degree to which beneficiaries who consented to participate were exposed to the Health Buddy® Program at Montefiore programmatic interventions. The analyses are designed to answer a broad policy question about the depth and breadth of the reach into the community: how well did the Health Buddy® Program at Montefiore engage their intended audiences? Specific research questions include the following:

- How many individuals did the Health Buddy® Program at Montefiore engage, and what were the characteristics of the participants versus nonparticipants (in terms of baseline clinical measures, demographics, and health status)?
- What beneficiary characteristics predict participation?
- To what extent were the intended audiences exposed to the Health Buddy® Program at Montefiore programmatic interventions? To what extent did participants engage in the various features of the program?
- What beneficiary characteristics predict a high level of intervention versus a low level of intervention?

The overall design of the CMHCB demonstration followed an intent-to-treat (ITT) model, and all CMOs are held at risk for their monthly management fees based on the performance of the full population of eligible beneficiaries randomized to the intervention group and compared with all eligible beneficiaries in the comparison group. The CMHCB demonstration was designed to provide strong incentives to gain participation by all eligible beneficiaries in the intervention group. In our May 2010 site visit (four and a half months into the outreach period), RBHC staff reported that the program had enrolled just 50% of its enrollment target of 2,400 participants for Phase II; there were 3,000 beneficiaries with no disposition (e.g., no answer, undecided, left message, bad phone number), and 600 soft refusals (e.g., those who agreed to future calls) (Lenfestey and McCall, 2011). In this report, we examined the level of participation for the full intervention period for the Phase I Original and Refresh populations and the Phase II population and the beneficiary characteristics that predict participation.

We also examined the level of intervention between the Health Buddy® Program at Montefiore and its beneficiaries with the Health Buddy® device. The main intervention for the Health Buddy® Program at Montefiore was the Health Buddy® health monitoring device, which collects qualitative and quantitative survey information from beneficiaries on a daily basis. The Health Buddy® Program at Montefiore also offered an alternate program for beneficiaries who

are unable or unwilling to use the Health Buddy® device. Furthermore, this program involved care management support provided through routinely scheduled telephone calls with care managers or telephone calls in response to data transmitted through the Health Buddy®. During the routine calls, nurses asked participants who do not use the Health Buddy® device similar questions to those programmed into the device. However, these responses were not entered into the Health Buddy® desktop—the data repository used to create the intervention data files. Thus, the intervention data files contain only information from beneficiaries who use the device. Therefore, we examined the number of telephonic contacts between Health Buddy® Program at Montefiore staff and their participants with the Health Buddy® device. For each participating beneficiary, the Health Buddy® Program at Montefiore provided RTI with a count of the number of telephonic contacts by type: inbound and outbound. Information on who was contacted (e.g., caregiver, patient, or physician) and number of completed surveys was also provided.

3.2 Methods

3.2.1 Participation Analysis Methods

We determined participation status during the demonstration period using a monthly indicator provided to us by ARC in the *Participant Status* file to align with dates of eligibility for the Health Buddy® Program at Montefiore[4]. We reported the percentage of intervention beneficiaries who consented to participate for at least 1 month during the intervention period as well as those who never consented to participate and the reason for nonparticipation (refused or never contacted/unable to be reached). We also reported the percentage of beneficiaries who, after initial consent, were continuous participants (while eligible for the Health Buddy® Program at Montefiore) and the percentage of beneficiaries participating for more than 75% of their eligible months.[5] These latter two sets of numbers provided an estimate of the number of beneficiaries with whom the Health Buddy® Program at Montefiore had the greatest opportunity to intervene. Because beneficiaries lose eligibility for various reasons over time (e.g., loss of Part A or Part B benefits, or due to death), we reported counts of full-time equivalents (FTEs) or numbers of intervention and comparison beneficiaries weighted by the fraction of the demonstration period each beneficiary was eligible. Only beneficiaries who were eligible on the first day of the Phase II demonstration are included in these analyses.

We also conducted a multivariate logistic regression analysis to determine the predictors of participation versus nonparticipation among those in the intervention group. The logistic model used in this study to identify differences in the likelihood of a beneficiary being in the participant group versus the nonparticipant group as a function of baseline and intervention period clinical factors, baseline cost, and baseline demographic factors is specified as

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[4] No participation data were provided for the last two months of the Phase II demonstration, so these months were excluded from the participation analysis.

[5] A beneficiary becomes ineligible to participate if he/she enrolls in a Medicare Advantage (MA) plan, loses eligibility for Part A or B of Medicare, moves out of the demonstration area, gets a new primary payer (i.e., Medicare becomes secondary payer), develops ESRD, elects the hospice benefit, or dies.

$$\text{Log e } (p_i / [1 - p_i]) = \beta X_i + \text{error}, \qquad (3.1)$$

where P_i = the probability that the *i*th individual will consent to participate, βX_i = an index value for the *i*th individual based on the person's specific set of characteristics (represented by the vector), and e = the base of natural logarithms. The probability of a beneficiary being in the participant group is thus explained by the variables.

Logistic regression produces an odds ratio for every predictor variable in the model; that is, an estimate of that variable's effect on the dependent variable, after adjusting for the other variables in the model. The odds ratio is greater than 1.0 when the presence (or higher value) of the variable is associated with an increased likelihood of being in the participant group versus the nonparticipant group; odds ratios less than 1.0 mean that the variable is inversely associated with being in the participant group.

The participation regression model investigates whether group membership is influenced by beneficiary demographic attributes, clinical characteristics, and utilization and cost factors previously defined in ***Chapter 2***. The demographic variables included in the model are defined as follows from the Medicare enrollment database (EDB) and determined at the time of Phase II eligibility determination by ARC (May 11, 2009) for the Phase I Original and Refresh populations and the date of assignment (September 22, 2009) for the Phase II population.

- male, a dichotomous variable, set at 1 for males;
- African American/other/unknown, a dichotomous variable, set at 1 for beneficiaries whose race code is African American, other, or unknown;
- aged-in, a dichotomous variable, set at 1 for beneficiaries whose entitlement to Medicare benefits is based on age rather than disability;
- age, three dichotomous variables set at 1 for age less than 65 years, age 75-84, and age greater than or equal to 85 years; age 65-74 is the reference group; and
- Medicaid, a dichotomous variable, set at 1 for beneficiaries enrolled in Medicaid. Medicaid enrollment is based on a beneficiary being enrolled in Medicaid at any point 1 year prior to the go-live date.

Baseline clinical and financial characteristics included in the model are dichotomous variables set at 1 for the medium and high groups with the low group as the reference group. The categories were determined for each population based on tertiles and then the regressions run by cohort. Baseline clinical and financial characteristics included in the model are defined as follows:

- baseline HCC score medium and high, two dichotomous variables set at 1 if the prospective HCC score was from 0.71 to 1.52 (medium) and greater than 1.52 (high); HCC score less than 0.71 is the reference group for the Phase I Original population. For the Phase I Refresh population, a score from 0.76 to 1.63 was defined as medium and high was greater than 1.63; and HCC score less than 0.76 was the reference

group. A medium HCC score was defined as from 1.55 to 2.44 for the Phase II population, with high scores identified as those greater than 2.44 and the reference group were beneficiaries with scores less than 1.55.

- baseline Charlson score medium and high, two dichotomous variables set at 1 if the Charlson index score was 2 or 3 (medium) and 4 or greater than (high); Charlson score of less than 2 is the reference group for the all three populations.

- baseline PBPM costs medium and high, two dichotomous variables set at 1 if the PBPM cost calculated by RTI for a 12-month period prior to the *start* of the Phase II Health Buddy® Program at Montefiore Demonstration for the Phase I Original population was greater than or equal to $356 and less than $1,388 (medium) and $1,388 or greater (high); PBPM cost less than $356 is the reference group for the original population. For the Phase I Refresh population, baseline PBPM costs greater than or equal to $358 and less than $1,292 were assigned to the medium group and $1,292 or greater to the high category; PBPM cost less than $358 is the reference group. Baseline PBPM costs greater than or equal to $474 and less than $1,749 were assigned to the medium group and $1,749 or greater to the high category; PBPM cost less than $474 is the reference group for the Phase II population.

Intervention period beneficiary characteristics included in the model are defined as follows:

- died, a dichotomous variable, set at 1 for beneficiaries who died during the intervention period; and

- institutionalized, a dichotomous variable, set at 1 for beneficiaries who were resident in a long-term care setting for any 1 or more months of the initial 6 months of the intervention period.

3.2.2 Level of Intervention Analysis Methods

The Phase II Health Buddy® Program at Montefiore provided RTI with the number and nature of contacts with participating beneficiaries at the beneficiary level for the Phase II demonstration, thus we included all the data for the full 25 months of the Phase I Original and Refresh populations and 19 months of the Phase II population. We used these data to develop estimates of the level of intervention provided to Health Buddy® device participants. The Phase II Health Buddy® Program at Montefiore Demonstration model was comprised of a combination of centralized telephonic care management and integration of the Health Buddy® telehealth device in an integrated health care delivery network. The program provided the following services for participants: in-home monitoring and education using the Health Buddy® device; improved access to health services and healthcare coordination; medication adherence assistance; and health education (Lenfestey and McCall, 2011).

Using the encounter data submitted by the Phase II Health Buddy® Program at Montefiore, we constructed counts of the number of telephonic contacts with Health Buddy® device participants (both inbound and outbound), in total, and by who was contacted or doing the contacting: patient, provider, or caregiver. We report the mean and median number of total

contacts and the distribution of beneficiaries across six categories of contacts (0, 1, 2-4, 5-9, 10-19, and 20 or more). We also estimate a multivariate logistic regression model of the likelihood of being in the high total contact category relative to the low total contact category. A dichotomous dependent variable was created and set at 1 for beneficiaries who had a high level of contact with the Phase II Health Buddy® Program at Montefiore Demonstration and 0 for beneficiaries who had a low level of contact based upon the distributional properties of number of contacts. Beneficiaries who had a medium level of contact with the Phase II Health Buddy® Program at Montefiore Demonstration were the reference group in the regression analysis. Independent variables in the contact regression model included those that we have described for the participation regression model and two additional demonstration period utilization measures:

- intervention hospitalizations, two dichotomous variables set at 1 for:
  - one intervention period hospitalization set at 1 if the beneficiary had one hospitalization in months 14-25 for the Phase I Original and Refresh populations and months 8-19 for the Phase II population;
  - multiple intervention period hospitalizations set at 1 if the beneficiary had more than one hospitalization during the same time periods; and
  - No hospitalizations during the same time periods as the reference group.

We included these two additional demonstration period intervention variables because Phase II Health Buddy® Program at Montefiore Demonstration staff attempted to identify beneficiaries at risk of a hospitalization and to intervene to prevent the hospitalization from occurring or to identify beneficiaries at the time of hospitalization or shortly thereafter to intervene to prevent readmission. Thus, we would expect these two variables to be positively associated with being in the high contact group.

3.3 Findings

3.3.1 Participation Rates for the Phase II Health Buddy® Program at Montefiore Demonstration Populations

Analyses presented in this section include only beneficiaries who had at least 1 day of eligibility in the year prior to the start of the intervention period and at least 3 months of eligibility during the Phase II demonstration period. The results are based on the full demonstration period for both the original and refresh populations minus the last two months. The number of months included in this analysis is 23 months for the Phase I Original and Refresh populations and 17 months for the Phase II population.

Table 3-1 displays the number of beneficiaries included in our participation analyses for the three Phase II populations and illustrates the impact of loss of eligibility by reporting the FTEs. We report

1. Number of beneficiaries. The number of beneficiaries is equal to all beneficiaries who had at least 1 day of eligibility in the 1-year baseline period and 3 months of eligibility during the Phase II demonstration period.

2. Full-time equivalents. FTEs defined as the total number of beneficiaries weighted by the number of days eligible in the intervention period divided by the total number of days in the intervention period. For example, a beneficiary in the Phase II Health Buddy® Program at Montefiore Demonstration program had a total of 23 months (or 699 days) of possible enrollment. If he/she died after 90 days, their FTE value would be 90/699 or 0.129 FTEs. If someone were eligible for all 23 months, then his or her value is 1. The sum of this value across all beneficiaries gives the total FTE value reported.
3. Number fully eligible. The number fully eligible is the number of beneficiaries that had no gap in the Phase II Health Buddy® Program at Montefiore Demonstration eligibility during the demonstration period.

The ratio of FTEs to the total number of eligible beneficiaries in the Phase I Original intervention population is 0.87 for the intervention period (months 1-23). The FTE illustrates the effect of attrition over time of the original beneficiaries due primarily to death. Beneficiaries also became ineligible for participation in the Phase II Health Buddy® Program at Montefiore Demonstration if they joined a Medicare Advantage (MA) plan, lost Medicare Part A or B eligibility or Medicare became a secondary payer, developed ESRD, elected the hospice benefit, or moved out of the service area. Note that beneficiaries who become ineligible during the Phase II Demonstration program are removed from the intervention and comparison groups for the remainder of the demonstration.

Twenty-six percent of the Phase II Original intervention and comparison beneficiaries had a spell of ineligibility. This can be estimated as the difference in the number of eligible beneficiaries and the number of fully eligible beneficiaries. Within the intervention group, eligibility was higher for participants and lower for nonparticipants. The Phase I Original population nonparticipant group was eligible 85% of all possible days—slightly lower than the 90% of days for participants. Also, the participant group had a higher rate of beneficiaries being fully eligible for the entire intervention period (77%) compared with 71% for the nonparticipant group.

Table 3-1 also displays eligibility data for the Phase I Refresh population. The ratio of total number of beneficiaries to FTEs was about 0.88 for the intervention and comparison populations, indicating a 12% attrition rate over the course of the Phase II Demonstration period. However, the percent of beneficiaries that were fully eligible for the full refresh time period is higher among participants (80%) than nonparticipants (72%) or the comparison group (74%).

The Phase II population eligibility data can also be found in ***Table 3-1***, which is nearly 250% larger than the size of the Phase I Original population and more than six times larger than the Phase I Refresh population. The ratio of total number of beneficiaries to FTEs was 0.93 for both the intervention and comparison groups, a lower attrition rate than the other populations due to a shorter time period of evaluation. The percent of beneficiaries that were fully eligible for the full refresh time period is higher among participants (86%) than nonparticipants (81%) and only slightly higher than the comparison group (84%).

Table 3-1
Number of Medicare FFS beneficiaries eligible for and participating in the Phase II Health Buddy® Program at Montefiore CMHCB Demonstration

Characteristics	Phase I Original Months 1-23[1]	Phase I Refresh Months 1-23[1]	Phase II Population Months 1-17[1]
Intervention group			
Number eligible[2]	1,691	650	4,127
Full time equivalent[3]	1,479	569	3,823
Number fully eligible[4]	1,251	493	3,421
Participants			
Number eligible	812	321	1,425
Full time equivalent	734	288	1,354
Number fully eligible	629	256	1,219
Participants > 75%			
Number eligible	325	133	349
Full time equivalent	302	122	346
Number fully eligible	270	109	337
Non-participants			
Number eligible	879	329	2,702
Full time equivalent	745	281	2,470
Number fully eligible	622	237	2,202
Comparison group			
Number eligible	1,013	597	4,188
Full time equivalent	875	525	3,884
Number fully eligible	734	441	3,501

NOTES: FFS = fee-for-service; CMHCB = Care Management for High Cost Beneficiaries.

[1] No participation information was available at the time analysis for the last 2 months of the demonstration.

[2] Numbers reported for the intervention periods include only persons who have some baseline eligibility and at least 3 months of eligibility during the Phase II demonstration period.

[3] Counts of beneficiaries are adjusted for CMHCB program eligibility during the entire period the Care Management Organization (CMO) was active in the program.

[4] Number fully eligible is the number of beneficiaries that had no gap in the Phase II Health Buddy® Program at Montefiore Demonstration eligibility during the demonstration period

SOURCES: Medicare claims data, Medicare enrollment database.

Program: tableHBE-1A

Table 3-2 presents participation rates for the three Phase II Health Buddy® Program at Montefiore Demonstration populations and display the participation status of the beneficiary after verbal consent to participate was given (continuous participation, became a continuous nonparticipant after initial participation period, or intermittent participation). We also display the reasons for nonparticipation and the percent of beneficiaries who participated more than 75% of eligible months. Numbers of participants by selected months are also reported. Continuous versus truncated participation is important because it affects the ability of the Phase II Health Buddy® Program at Montefiore Demonstration to contact beneficiaries and, ultimately, have any impact on utilization and costs.

Participation rates for the Phase I Original population. Of all Phase I Original intervention group beneficiaries, 48% verbally consented to participate in its program at some point during the intervention period. Only 16% of beneficiaries were continuous participants (***Table 3-2***), which equates to one-third of participants. Among the Phase I Population beneficiaries, 26% refused to participate. The percent not contacted or unable to be located was also 26%.

Participation rates were heavily influenced by length of eligibility during the intervention period. An alternative measure of participation is the percentage of beneficiaries who participated more than 75% of months they were eligible for the Health Buddy® Program at Montefiore Demonstration (excluding the two months for which we did not have participation data). Of the Phase I Original intervention beneficiaries, 19% participated for more than 75% of their eligible months, which is slightly higher than the continuous participant percentage. ***Table 3-2*** also reports the number of participants over time (for months 6, 12, and 23, the last month of the demonstration with participation data reported). The number of participants had a slight increase at the beginning due to recruitment efforts and then declined over time as would be expected given the attrition due to loss of eligibility primarily due to death.

Participation rates for the Phase I Refresh population. The criteria for selection of the intervention and comparison Phase I Refresh populations were similar to the criteria used to select the initial Phase I Original populations with one noted exception. Montefiore Medical Center (MMC) expanded the list of CPT and Place of Service codes to exclude more residents of SNFs and nursing homes. With the selection criterion change, the refresh population had higher rates of participation than the original population. During Phase II, the participation rates were comparable between the Phase I Original and Refresh populations.

Participation rates for the Phase II population. The Health Buddy® Program at Montefiore increased the number of ZIP codes and lowered the HCC score threshold criteria for the selection of the Phase II population. During Phase II, the participation rates were significantly lower for the Phase II population (35%) than the other two populations, although nearly one-half were continuous participants. The percent of beneficiaries participating more than 75% of eligible months is markedly lower than the continuous enrollment percentage. This is indicative of the difficulty in recruiting Phase II population participants at the beginning of the demonstration.

Table 3-2
Participation in the Phase II Health Buddy® Program at Montefiore CMHCB Demonstration

Characteristics	Phase I Original	Phase I Refresh	Phase II Population
Number of intervention months[1]	23	23	17
Participation rate (entire demonstration period)	48%	49%	35%
Length of participation			
Continuous participation after engagement	16%	19%	17%
After initial participation, became a continuous non-participant	25%	25%	17%
Intermittent participation	8%	5%	0%
Nonparticipation (never agreed)	52%	51%	65%
Refused to participate when contacted	26%	29%	27%
Not contacted/unable to be contacted	26%	21%	39%
Beneficiaries participating more than 75% of eligible months	19%	20%	8%
Number of participants in selected months[2]			
Month 6	420	160	854
Month 12	425	173	900
Last month[3]	310	134	667

NOTES: CMHCB = Care Management for High Cost Beneficiaries.

[1] No participation information is available for the last 2 months of the demonstration.

[2] Numbers reported for the intervention periods include only persons who have some baseline eligibility and at least 3 months of eligibility during the Phase II demonstration period.

[3] The last month represents month 23 for the Phase I Original and Refresh populations and month 17 for the Phase II population.

Data Sources: Medicare claims data, Medicare enrollment database.

Program: tableHBE-2A.sas

3.3.2 Characteristics of Participants in the Phase II Health Buddy® Program at Montefiore Demonstration Populations

In order to better understand the characteristics that most strongly predicted participation in the demonstration, we estimated a logistic regression model for the Phase I Original and Refresh and Phase II populations:

- Beneficiaries who participated at least 75% of eligible months compared with all other beneficiaries (nonparticipants and minimal participants).

This model reflects characteristics of the beneficiaries who demonstrated the greatest willingness or ability to participate in the Phase II Health Buddy® Program at Montefiore Demonstration. We estimated two equations; an equation with just demographic characteristics and a full model equation that includes baseline and demonstration utilization and health status variables. Because there is correlation between beneficiary characteristics and the other variables, such as health status and baseline characteristics, we were most interested in examining which beneficiary characteristics had the greatest effect on willingness to participate before controlling for these other factors.

Tables 3-3 through 3-5 present the results of the logistic regression analyses that predict participation based on various beneficiary characteristics for the Phase I Original and Refresh populations and the Phase II population. Model A (columns 1 and 2) contains the odds ratio and associated statistical level of significance for the equation with just beneficiary characteristics. Model B (columns 3 and 4) contains the odds ratio and associated statistical level of significance for the equation with additional utilization and health status variables. An odds ratio less than 1 means that beneficiaries with a particular characteristic were less likely to participate; an odds ratio greater than 1 means that beneficiaries with the particular characteristic were more likely to participate. In general, the reference group comprises characteristics associated with younger and healthier beneficiaries. The explanatory power of the studied beneficiary characteristics was extremely low. Thus, the set of variables that we used were not strong predictors of likelihood of participation. Pseudo R-squares for all of the models were 0.08 or less, with the full model exhibiting pseudo R-squares of 0.08 for the Phase I Original and Refresh populations and 0.03 for the Phase II population.

Table 3-3
Logistic regression modeling results comparing beneficiaries that participated at least 75% of eligible months during the Phase II Health Buddy® Program at Montefiore CMHCB Demonstration: Phase I Original Population [1,2]

Characteristics	Demographic Model A OR	*p-value*[3]	Full Model B OR	*p-value*[3]
Intercept	0.31	**	0.17	**
Beneficiary characteristics				
Male	1.47	**	1.51	**
African American/other/unknown	1.59	**	1.63	**
Age < 65 years	0.57	N/S	0.50	N/S
Age 75-84	0.63	**	0.62	**
Age 85 + years	0.51	**	0.55	**
Medicaid	1.00	N/S	1.00	**
Baseline characteristics				
Baseline HCC score medium	N/I	N/I	1.24	N/S
Baseline HCC score high	N/I	N/I	1.41	N/S
Medium baseline PBPM	N/I	N/I	1.36	N/S
High baseline PBPM	N/I	N/I	1.82	**
Baseline Charlson score medium	N/I	N/I	0.98	N/S
Baseline Charlson score high	N/I	N/I	2.20	**
Demonstration period health status				
Died	N/I	N/I	0.46	**
Institutionalized	N/I	N/I	0.95	*
Number of cases	1,691	N/A	1,691	N/A
Chi-square (p<)	36.16	**	146.97	**
Pseudo R-square	0.02	N/A	0.08	N/A

NOTES: CMHCB = Care Management for High Cost Beneficiaries; OR = odds ratio; HCC = Hierarchical Condition Category; PBPM = per beneficiary per month.

[1] Numbers reported for the intervention periods include only persons who have some baseline eligibility and at least 3 months of eligibility during the Phase II demonstration period.

[2] The regressions are adjusted for CMHCB program eligibility during the entire period the Care Management Organization (CMO) was active in the demonstration.

[3] * denotes statistical significance at the 5% level;** denotes statistical significance at the 1% level.

N/I means not included; N/A means not applicable; N/S means not statistically significant.

The baseline HCC score reference group is <0.71. The age reference group is 65-74 years. The PBPM reference group is < $356. The baseline Charlson score reference group is < 2.

Data Sources: RTI analysis of 2008-2011 Medicare enrollment, eligibility, claims and encounter data.

Program: bene04a rangesa partab4ab partab3ab

Table 3-4
Logistic regression modeling results comparing beneficiaries that participated at least 75% of eligible months during the Phase II Health Buddy® Program at Montefiore CMHCB Demonstration: Phase I Refresh Population [1,2]

Characteristics	Demographic Model A OR	*p-value*[3]	Full Model B OR	*p-value*[3]
Intercept	0.26	**	0.14	**
Beneficiary characteristics				
Male	1.13	N/S	1.09	N/S
African American/other/unknown	1.82	**	1.66	*
Age < 65 years	1.07	N/S	0.80	N/S
Age 75-84	0.87	N/S	0.88	N/S
Age 85 + years	0.50	*	0.46	*
Medicaid	1.00	N/S	1.00	N/S
Baseline characteristics				
Baseline HCC score medium	N/I	N/I	2.15	**
Baseline HCC score high	N/I	N/I	2.21	*
Medium baseline PBPM	N/I	N/I	1.43	N/S
High baseline PBPM	N/I	N/I	1.42	N/S
Baseline Charlson score medium	N/I	N/I	0.81	N/S
Baseline Charlson score high	N/I	N/I	1.68	N/S
Demonstration period health status				
Died	N/I	N/I	0.49	N/S
Institutionalized	N/I	N/I	0.86	N/S
Number of cases	650	N/A	650	N/A
Chi-square (p<)	15.95	*	50.97	**
Pseudo R-square	0.02	N/A	0.08	N/A

NOTES: CMHCB = Care Management for High Cost Beneficiaries; OR = odds ratio; HCC = Hierarchical Condition Category; PBPM = per beneficiary per month.

[1] Numbers reported for the intervention periods include only persons who have some baseline eligibility and at least 3 months of eligibility during the Phase II demonstration period.

[2] The regressions are adjusted for CMHCB program eligibility during the entire period the Care Management Organization (CMO) was active in the demonstration.

[3] * denotes statistical significance at the 5% level;** denotes statistical significance at the 1% level.

N/I means not included; N/A means not applicable; N/S means not statistically significant.

The baseline HCC score reference group is <0.76. The age reference group is 65-74 years. The PBPM reference group is < $358. The baseline Charlson score reference group is < 2.

Data Sources: RTI analysis of 2008-2011 Medicare enrollment, eligibility, claims and encounter data.

Program: bene04a rangesa partab4ab partab3ab

Table 3-5
Logistic regression modeling results comparing beneficiaries that participated at least 75% of eligible months during the Phase II Health Buddy® Program at Montefiore CMHCB Demonstration: Phase II Population [1,2]

Characteristics	Demographic Model A OR	*p-value*[3]	Full Model B OR	*p-value*[3]
Intercept	0.08	**	0.05	**
Beneficiary characteristics				
Male	0.88	N/S	0.88	N/S
African American/other/unknown	2.25	**	2.26	**
Age < 65 years	1.30	N/S	1.27	N/S
Age 75-84	0.79	N/S	0.81	N/S
Age 85 + years	0.65	*	0.70	*
Medicaid	1.00	N/S	1.00	N/S
Baseline characteristics				
Baseline HCC score medium	N/I	N/I	1.28	N/S
Baseline HCC score high	N/I	N/I	1.42	N/S
Medium baseline PBPM	N/I	N/I	1.31	N/S
High baseline PBPM	N/I	N/I	1.42	*
Baseline Charlson score medium	N/I	N/I	1.28	N/S
Baseline Charlson score high	N/I	N/I	1.42	N/S
Demonstration period health status				
Died	N/I	N/I	0.10	**
Institutionalized	N/I	N/I	0.98	*
Number of cases	4,127	N/A	4,127	N/A
Chi-square (p<)	70.91	**	128.49	**
Pseudo R-square	0.02	N/A	0.03	N/A

NOTES: CMHCB = Care Management for High Cost Beneficiaries; OR = odds ratio; HCC = Hierarchical Condition Category; PBPM = per beneficiary per month.

[1] Numbers reported for the intervention periods include only persons who have some baseline eligibility and at least 3 months of eligibility during the Phase II demonstration period.

[2] The regressions are adjusted for CMHCB program eligibility during the entire period the Care Management Organization (CMO) was active in the demonstration.

[3] * denotes statistical significance at the 5% level;** denotes statistical significance at the 1% level.

N/I means not included; N/A means not applicable; N/S means not statistically significant.

The baseline HCC score reference group is <1.55. The age reference group is 65-74 years. The PBPM reference group is < $474. The baseline Charlson score reference group is < 2.

Data Sources: RTI analysis of 2008-2011 Medicare enrollment, eligibility, claims and encounter data.

Program: bene04a rangesa partab4ab partab3ab

Model A for the Phase I Original population shows that beneficiaries who were male or non-white were more likely to be participants, while older beneficiaries were less likely to participate, a proxy for poorer health status (***Table 3-3***). Examining Model B for the Phase I Original population (***Table 3-3***), we do observe the same pattern of influence of beneficiary characteristics on the likelihood of participation. Although Medicaid is shown to be a statistically strong predictor of continued participation, this is driven by a small standard error – 31% of beneficiaries that participated more than 75% of eligible months were enrolled in Medicaid compared to 33% of the rest of the Phase I Original population. Demonstration period health status based on HCC score was a strong predictor of participation. Beneficiaries who died and were institutionalized during the first 6-month period of the demonstration were less likely to participate holding other factors constant. Note that there were 97 Phase I Original population beneficiaries that were institutionalized, but only 1 was in the high participation group. The Phase II Health Buddy® Program at Montefiore Demonstration made an effort to exclude beneficiaries in skilled nursing facilities or nursing homes from the intervention population. High baseline per beneficiary per month (PBPM) expenditures and high baseline Charlson scores corresponded with beneficiaries being more likely to participate more than 75% of eligible month when controlling for baseline demographics and demonstration period health status. Thus, it appears that the Phase II Health Buddy® Program at Montefiore Demonstration was able to target some of the beneficiaries predicted to be sickest during the demonstration period for participation.

There are a few noted differences between participants and nonparticipants for the Phase I Refresh population (***Table 3-4***); demonstration period health status had no significant impact on participation. Medium and high baseline HCC scores were correlated with a higher likelihood of participation. Beneficiaries in the Phase II population were less likely to participate if they were more than 85 years of age, died, or were institutionalized (***Table 3-5***). Beneficiaries with high baseline PBPMs were more likely to participate more than 75% of eligible month when controlling for baseline demographics and demonstration period health status. A small percentage of Phase II beneficiaries met the criterion for participation more than 75% of months (8.5%).

3.3.3 Level of Intervention

In this section, we report the frequency of interaction between the Phase II Health Buddy® Program at Montefiore Demonstration intervention beneficiaries for a subset of intervention population beneficiaries who had the Health Buddy® device at any point during the Phase II Demonstration period. Encounter data were only provided for beneficiaries with the Health Buddy® device. The Health Buddy® is a health monitoring device that collects qualitative and quantitative information from patients on a daily basis. Care managers monitor patient responses to surveys conducted via the device and follow up with patients to help them address clinical issues and initiate interventions as needed to maintain their health. We also examine whether there is evidence of selective targeting of beneficiaries for intervention contacts based upon level of perceived need as determined by beneficiary demographic, health status, baseline costliness, and acute care utilization during the demonstration period.

Descriptive statistics were performed using beneficiaries participating in the Phase II Health Buddy® Program at Montefiore Demonstration to determine the breadth and depth of contacts

related to care management. RTI received quarterly data from RBHC, thus, the reported nine quarters of data represent information on beneficiaries with the Health Buddy® device at any point during 25 months for the Phase I Original and Refresh populations and 19 months for the Phase II population. ***Table 3-6*** provides counts of beneficiaries that had the Health Buddy® device by quarter and the percent of eligible beneficiaries with the device. Roughly 22% of the Phase II Health Buddy® Program at Montefiore Demonstration eligible intervention beneficiaries used the Health Buddy® device during the demonstration period.

Table 3-6
Frequency and percent of Phase II Health Buddy® Program at Montefiore CMHCB Demonstration eligible beneficiaries with the Health Buddy® device by quarter

Quarter	Number of beneficiaries – Phase I Original population	Percent of eligibles	Number of beneficiaries – Phase I Refresh population	Percent of eligibles	Number of beneficiaries – Phase II population	Percent of eligibles
Never had a device	1,325	78.4	494	76.0	3,250	78.8
1	105	6.2	28	4.3	n/a	n/a
2	246	14.5	86	13.2	n/a	n/a
3	256	15.1	104	16.0	11	0.3
4	235	13.9	110	16.9	315	7.6
5	233	13.8	109	16.8	621	15.0
6	236	14.0	102	15.7	632	15.3
7	215	12.7	95	14.6	604	14.6
8	194	11.5	92	14.2	543	13.2
9	124	7.3	58	8.9	329	8.0

Data Sources: RTI analysis of 2008-2011 Medicare enrollment, eligibility, and RBHC encounter data.

Program: enctab1a

Table 3-7 provides the number of beneficiaries that had the Health Buddy® device at any point during the Phase II Demonstration, the length of time they had the device, and their utilization of the device (as measured by the number of surveys completed on the device). There were 812 Phase I Original population beneficiaries that agreed to participate in the Phase II Demonstration. Of these, 366 (45%) agreed to use the device for at least 1 quarter during the full 25 month period. On average, beneficiaries had the device for 5 of the 9 quarters and completed 203 surveys, which equates to about 41 surveys per quarter. Of the 203 surveys, 21 (10%) included high risk responses (knowledge, behavior, symptoms or general high risk), which were intended to be triggers for care managers responses. The majority of high risk responses were categorized as high risk symptoms responses. Among the Phase I Refresh population (***Table 3-7***), there were 321 beneficiaries that agreed to participate in the Phase II Demonstration. Of these, 156 (49%) agreed to use the device

for at least 1 quarter during the full 25 month period. On average, beneficiaries had the device for 5 of the 9 quarters and completed 186 surveys, which equates to about 37 surveys per quarter. Of those 186 surveys, 19 (10%) included high risk responses.

The Phase II population beneficiaries were examined for 7 quarters (19 months). ***Table 3-7*** shows that there were 1,425 beneficiaries that agreed to participate, and of those, 877 agreed to use the Health Buddy® device (62%). On average, beneficiaries had the device for 4 of the 7 quarters and completed 129 surveys (about 32 surveys per quarter). Nearly 11% of those surveys were high risk responses.

The Phase II Health Buddy® Program at Montefiore Demonstration provided data on the number of telephonic contacts per beneficiary with the Health Buddy® device by quarter. ***Table 3-8*** provides a summary of these contacts by type of contact (outbound and inbound) and by who was contacted (patient, physician, or care manager). In all three populations, the majority of contacts were made by the care managers to the patient ranging from 72% of contacts for the Phase I Original population to nearly 85% of the Phase II population. Calls from the patient to the care manager were the second most frequent form of contact. Outbound telephonic contact was the dominant form of contact.

Table 3-9 displays the mean number of telephonic contacts and quarters of contact for the Phase I Original population beneficiaries with the Health Buddy® device (n = 366). It also provides the overall distribution of telephonic contacts for the original population. Observations were weighted by the fraction of eligible days, accounting for fewer contacts due to attrition because of death, which resulted in 340 full-time equivalent beneficiaries. The mean number of contacts for each beneficiary was 11 and the median was 7. On average, there was at least one telephonic correspondence with or regarding the beneficiary in 3 of the 9 quarters. One-quarter of beneficiaries had less than 14 contacts and nearly 50% of beneficiaries had 36 or more contacts over the 9-quarter period. ***Table 3-9*** also displays this same information for the Phase I Refresh population. A total of 156 unique Phase I Refresh population beneficiaries met the inclusion criteria for this analysis (144 full-time equivalents). The refresh population had a lower percentage of beneficiaries with less than 14 contacts (18%) and a lower percentage of beneficiaries with 36 or more contacts (43%).

The Phase II population had a total of 877 beneficiaries (832 full-time equivalents) that used the Health Buddy® device. On average, a beneficiary had 6 contacts over the 7 months of the Phase II Demonstration period (***Table 3-9)***. This population had a higher percentage of beneficiaries with less than 14 contacts (34%) and a lower percentage of beneficiaries with 36 or more contacts (27%). This is not surprising given the shorter period of time these beneficiaries were in the Phase II Demonstration.

Table 3-7
Mean and median number of surveys and high risk responses completed by those beneficiaries with the Health Buddy® device

Statistic	Phase I Original population		Phase I Refresh population		Phase II population	
Number of beneficiaries with the Health Buddy® device[1]	366	—	156	—	877	—
FTE beneficiaries with the Health Buddy® device[2]	340	—	144	—	832	—
Measures of Health Buddy® device utilization	Mean	Median	Mean	Median	Mean	Median
Number of quarters with the Health Buddy® device	5	5	5	6	4	4
Number of completed surveys	203	145	186	138	129	83
Number of high risk knowledge responses	2	1	2	1	2	1
Number of high risk behavior responses	4	2	5	2	3	1
Number of high risk symptoms responses	13	5	11	5	8	4
Number of high risk general responses	2	1	2	1	1	1
Number of total high risk responses	21	11	19	10	14	8

NOTES: FTE = full time equivalent.

[1] Beneficiaries had to have had some baseline eligibility and at least 3 months of eligibility during the Phase II demonstration period and have agreed to use the Health Buddy® device.

[2] Beneficiary counts weighted by fraction of eligible days = full-time equivalents.

[3] Beneficiaries had to have completed at least one survey during the demonstration

Data Sources: RTI analysis of 2008-2011 Medicare enrollment, eligibility, and RBHC encounter data.

Program: enctab2a

Table 3-8
Frequency distribution of Phase II Health Buddy® Program at Montefiore CMHCB Demonstration care manager interactions: Total contacts[1,2]

	Phase I Original		Phase I Refresh		Phase II Population	
Contacted	Frequency	Percent	Frequency	Percent	Frequency	Percent
Outbound total	2,748	73.7	1,107	78.9	4,145	85.4
Patient	2,683	71.9	1,086	77.5	4,100	84.5
Physician	65	1.7	21	1.5	44	0.9
Inbound total	982	26.3	295	21.1	710	14.6
Patient to Care Manager	923	24.7	282	20.1	687	14.1
Physician to Care Manager	59	1.6	13	0.9	23	0.5
Total contacts	3,730	100.0	1,402	100.0	4,855	100.0

NOTES:

[1] Beneficiaries had to have had some baseline eligibility and at least 3 months of eligibility during the Phase II demonstration period and have agreed to use the Health Buddy® device.

[2] Beneficiary counts weighted by fraction of eligible days = full-time equivalents.

Data Sources: RTI analysis of 2008-2011 Medicare enrollment, eligibility, and RBHC encounter data.

Program: enctab2a

Table 3-9
Distribution of number of contacts with participants[1,2] in the Phase II Health Buddy® Program at Montefiore CMHCB Demonstration

Statistic	Phase I Original		Phase I Refresh		Phase II Population	
	Number	Percent	Number	Percent	Number	Percent
Mean number of contacts	11	—	10	—	6	—
Median number of contacts	7	—	6	—	4	—
Mean number of quarters of contact	3	—	3	—	2	—
Median number of quarters of contact	3	—	3	—	2	—
Distribution low to high contact variables	FTE beneficiaries	Percent	FTE beneficiaries	Percent	FTE beneficiaries	Percent
0-13 contacts	78	23.0%	26	18.3%	285	34.3%
14-35 contacts	97	28.5%	55	38.3%	324	39.0%
36+ contacts	165	48.5%	63	43.4%	222	26.7%
Total	340	100.0%	144	100.0%	832	100.0%

NOTES: FTE = full time equivalent.

[1] Participants are defined as beneficiaries with the Health Buddy® device.

[2] Beneficiary counts weighted by fraction of eligible days = full-time equivalents.

Data Sources: RTI analysis of 2008-2011 Medicare enrollment, eligibility, and RBHC encounter data.

Program: enctab2a enctab3a.sas

Table 3-10 displays the percent of Health Buddy® device participants with care manager interactions – telephone contacts inbound and outbound, and any contact (all telephonic) by frequency of contact over the full 25 months for the Phase I Original population. Outbound calls are care manager calls to a patient or a physician. Inbound calls are defined as calls to the care manager from the beneficiary or a physician. Given that outbound telephonic contact is most frequent, we find that more beneficiaries have at least 1 outbound call (87% compared to 66% for inbound contact) and nearly 11% have 20 or more outbound calls compared to inbound contacts (less than 1%). Less than 8% of beneficiaries had no telephonic contact, with over one-quarter of beneficiaries having 1 to 4 contacts during the 25-month period. Nearly 40% had 10 or more telephonic contacts of some form. This indicates that beneficiaries with the Health Buddy® device were in fairly frequent contact with their care manager and their care manager and physician were also in frequent contact. Similar results can be found for the Phase I Refresh population (***Table 3-10***), except that this population has lower rates of beneficiaries with no contact. The Phase II population ***(Table 3-10)*** had the highest rate of beneficiaries with no contact (over 11%). Due to the shorter time period in the Phase II Demonstration, Phase II beneficiaries have lower percentages of beneficiaries receiving 20 or more calls.

Tables 3-11 through 3-13 display the frequency of care manager contacts by baseline HCC score and type of telephonic contact. Contact by mode was not mutually exclusive in that a beneficiary could have a combination of inbound and outbound telephone contacts any time during the Phase II Demonstration period. Beneficiaries were stratified into three HCC categories based on tertile values. Across all three groups of beneficiaries we observe no clear pattern that the beneficiaries with the highest HCC scores have the greatest level of contact with program staff. For the Phase I Original population, nearly all beneficiaries in the lowest HCC risk score category had at least one telephonic contact (either inbound or outbound); however 11% of beneficiaries in the highest HCC risk score category had no phone contact. The reverse is true for the Phase I Refresh population. And, similar percentages of beneficiaries with no telephone contact were observed for the Phase II population regardless of risk score category.

Table 3-10
Percent distribution of participants[1] with Phase II Health Buddy® Program at Montefiore CMHCB Demonstration care manager interactions

Type and frequency of contact	Number of Phase I Original FTE beneficiaries[2]	Percent	Number of Phase I Refresh FTE beneficiaries[2]	Percent	Number of Phase II population FTE beneficiaries[2]	Percent
Telephonic inbound						
0	117	34.5	62	42.8	503	60.5
1	62	18.2	23	15.9	182	21.9
2-4	104	30.7	39	27.3	119	14.3
5-9	35	10.4	15	10.2	23	2.8
10-19	18	5.4	5	3.8	4	0.5
20+	3	0.9	0	0.0	1	0.1
Telephonic outbound						
0	46	13.4	15	10.1	126	15.2
1	31	9.3	14	9.7	100	12.1
2-4	74	21.6	37	25.5	263	31.6
5-9	98	28.8	37	25.7	216	25.9
10-19	56	16.3	28	19.4	103	12.4
20+	36	10.5	14	9.7	23	2.7
Any telephonic contact						
0	26	7.7	8	5.4	94	11.4
1	21	6.1	10	6.7	95	11.5
2-4	73	21.4	34	23.7	254	30.6
5-9	91	26.6	44	30.2	239	28.7
10-19	83	24.3	30	20.8	117	14.1
20+	47	13.9	19	13.2	31	3.8

NOTES: FTE = full time equivalent.
[1] Participants are defined as beneficiaries with the Health Buddy® device.
[2] Beneficiary counts weighted by fraction of eligible days = full-time equivalents.
Data Sources: RTI analysis of 2008-2011 Medicare enrollment, eligibility, and RBHC encounter data.
Program: enctab4a

Table 3-11
Frequency of Phase II Health Buddy® Program at Montefiore CMHCB Demonstration contacts by HCC score: Phase I Original intervention population

Contact mode	HCC Score Low (<.71) N = 89[1] Frequency	%	HCC Score Medium (.71-1.52) N = 118[1] Frequency	%	HCC Score High (>1.52) N = 132[1] Frequency	%
Telephonic inbound						
0	25	27.7	39	32.8	54	40.6
1	17	18.7	23	19.6	22	16.6
2-4	35	39.7	38	32.2	31	23.2
5-9	6	7.2	7	6.1	22	16.3
10-19	6	6.7	9	7.6	3	2.5
20+	0	0.0	2	1.7	1	0.8
Telephonic outbound						
0	8	9.1	15	12.3	23	17.4
1	11	12.2	11	9.3	10	7.2
2-4	20	22.4	24	20.0	30	22.5
5-9	27	30.1	39	32.8	32	24.5
10-19	12	13.9	18	14.8	26	19.4
20+	11	12.3	13	10.8	12	9.1
Total telephonic						
0	3	3.2	9	7.5	14	10.9
1	6	6.2	5	3.9	11	8.0
2-4	22	24.6	25	21.3	26	19.4
5-9	24	27.3	35	29.2	32	23.9
10-19	22	24.2	30	25.1	31	23.6
20+	13	14.5	15	13.0	19	14.2

NOTES: HCC =Hierarchical Condition Category; N = number of beneficiaries.

[1] Beneficiary counts weighted by fraction of eligible days = full-time equivalents

Data Sources: RTI analysis of 2008-2011 Medicare enrollment, eligibility, and RBHC encounter data.

Program: enctab4a.sas

Table 3-12
Frequency of Phase II Health Buddy® Program at Montefiore CMHCB Demonstration contacts by HCC score: Phase I Refresh intervention population

Contact mode	HCC Score Low (<.76) N = 36[1] Frequency	%	HCC Score Medium (.76-1.63) N = 64[1] Frequency	%	HCC Score High (>1.63) N = 45[1] Frequency	%
Telephonic inbound						
0	18	50.6	22	35.0	21	47.4
1	8	21.8	9	14.5	6	13.2
2-4	7	19.4	20	31.2	13	28.2
5-9	3	6.9	9	14.6	3	6.7
10-19	0	1.3	3	4.7	2	4.5
20+	0	0.0	0	0.0	0	0.0
Telephonic outbound						
0	5	14.6	6	9.8	3	7.0
1	5	12.5	4	7.0	5	11.2
2-4	11	29.8	11	17.4	15	33.4
5-9	10	28.0	17	27.2	10	21.5
10-19	4	9.7	18	27.6	7	15.7
20+	2	5.5	7	11.0	5	11.2
Total telephonic						
0	4	10.5	4	6.3	0	0.0
1	3	6.9	2	3.5	5	11.2
2-4	13	35.3	9	14.2	12	27.6
5-9	11	30.8	17	27.5	15	33.7
10-19	3	8.2	21	32.8	6	14.1
20+	3	8.3	10	15.7	6	13.4

NOTES: HCC =Hierarchical Condition Category; N = number of beneficiaries.

[1] Beneficiary counts weighted by fraction of eligible days = full-time equivalents

Data Sources: RTI analysis of 2008-2011 Medicare enrollment, eligibility, and RBHC encounter data.

Program: enctab4a.sas

Table 3-13
Frequency of Phase II Health Buddy® Program at Montefiore CMHCB Demonstration contacts by HCC score: Phase II intervention population

Contact mode	HCC Score Low (<1.55) N = 258[1] Frequency	%	HCC Score Medium (1.55-2.44) N = 305[1] Frequency	%	HCC Score High (>2.44) N = 268[1] Frequency	%
Telephonic inbound						
0	165	64.0	185	60.7	152	56.8
1	48	18.7	64	20.8	70	26.0
2-4	36	13.8	45	14.6	39	14.4
5-9	7	2.8	10	3.1	7	2.5
10-19	2	0.8	2	0.7	0	0.0
20+	0	0.0	0	0.0	1	0.4
Telephonic outbound						
0	41	15.9	48	15.8	37	13.9
1	28	10.9	43	14.0	29	10.9
2-4	93	36.1	95	31.0	76	28.2
5-9	63	24.3	78	25.6	75	27.9
10-19	26	9.9	34	11.3	43	16.1
20+	8	3.0	7	2.4	8	2.9
Total telephonic						
0	31	12.0	36	11.9	27	10.0
1	27	10.6	37	12.0	31	11.7
2-4	87	33.8	93	30.5	74	27.5
5-9	74	28.6	86	28.1	79	29.6
10-19	30	11.8	42	13.8	45	16.7
20+	8	3.2	11	3.7	12	4.4

NOTES: HCC =Hierarchical Condition Category; N = number of beneficiaries.

[1] Beneficiary counts weighted by fraction of eligible days = full-time equivalents

Data Sources: RTI analysis of 2008-2011 Medicare enrollment, eligibility, and RBHC encounter data.

Program: enctab4a.sas

To more directly examine the targeting strategy of the Phase II Health Buddy® Program at Montefiore Demonstration, a multivariate logistic regression model was estimated with the number of total contacts (inbound and outbound telephone calls) as the dependent variable. The model estimates the likelihood of a participant receiving a high number of contacts. The medium contact group was omitted, thus comparing the high contact group to the low contact group. ***Table 3-14*** display the odds ratios for discrete categories of demographic characteristics, baseline health status, baseline Medicare payments, and demonstration health status. Beneficiaries were weighted by their period of eligibility during demonstration, and their number of contacts categorized either as low (0-13) or high (36+). Odds ratios are partial in the sense that all other variables are held constant. For example, the odds of a Phase I Original population beneficiary in the high baseline PBPM cost category experiencing a high contact rate are 3.24 times greater than for a beneficiary in the low baseline PBPM cost category, adjusting for any baseline difference in HCC score and other characteristics. There were no other beneficiary characteristics or baseline characteristics found to be a statistically significant indicator of the likelihood of being in the high contact category. Demonstration period health status was not a strong predictor of a high level of contact. The explanatory power of the studied beneficiary characteristics was extremely low, suggesting that there is not a strong set of variables that predict likelihood of a beneficiary being in the high contact group. The pseudo R-square for this model was 0.05. Another challenge to finding statistically significant results is the very low number of observations: there are 90 beneficiaries in the low contact category and 173 in the high contact group. These numbers become even smaller once they are weighted by eligibility (78 and 165, respectively) which also indicates that a higher percentage of the low contact category lost eligibility.

For the Phase I Refresh population (***Table 3-14)***, none of the beneficiary, baseline, or demonstration period health status characteristics were found to be statistically significant indicators of the likelihood of being in the high contact category. Again, this model faced the challenge of a very small numbers of observations (29 beneficiaries in the low contact category and 68 in the high contact category) and the pseudo R-square for this model is also low (0.10).

Participants in the Phase II population are more likely to be in the high contact category if they had high baseline HCC scores and had one intervention period hospitalization (***Table 3-14)***. This coincides with the report by RBHC staff that, while there was a lack of access to an electronic medical record (EMR), information regarding patient admissions to Montefiore hospital was good. Hospitalization information was provided daily, but information was more limited from an integrated perspective.

Table 3-14
Logistic regression modeling results comparing the likelihood of being in the Phase II Health Buddy® Program at Montefiore CMHCB Demonstration high contact category relative to the low contact category

Characteristics	Phase I Original population OR[1,2,4]	*p-value*[3]	Phase I Refresh population OR[1,2,5]	*p-value*[3]	Phase II population OR[1,2,6]	*p-value*[3]
Intercept	0.85	N/S	0.32	N/S	0.36	N/S
Beneficiary characteristics						
Male	1.03	N/S	0.98	N/S	0.86	N/S
Age <65	0.80	N/S	2.16	N/S	1.40	N/S
Age 75-84	0.98	N/S	0.85	N/S	0.79	N/S
Age 85+ years	1.54	N/S	0.67	N/S	0.60	N/S
Baseline characteristics						
Baseline HCC score medium	0.85	N/S	2.47	N/S	1.17	N/S
Baseline HCC score high	0.66	N/S	1.43	N/S	1.79	*
Medium base PBPM	1.43	N/S	2.46	N/S	1.04	N/S
High base PBPM	3.24	**	1.87	N/S	0.79	N/S
Baseline Charlson score medium	0.79	N/S	0.78	N/S	0.79	N/S
Baseline Charlson score high	0.64	N/S	0.68	N/S	0.72	N/S
Demonstration period health status						
Died	0.54	N/S	0.47	N/S	0.69	N/S
Institutionalized	0.89	N/S	0.87	N/S	1.00	N/S
One hospitalization	1.07	N/S	1.56	N/S	1.59	*
Multiple hospitalizations	0.66	N/S	0.88	N/S	1.47	N/S

(continued)

Table 3-14 (continued)
Logistic regression modeling results comparing the likelihood of being in the Phase II Health Buddy® Program at Montefiore CMHCB Demonstration high contact category relative to the low contact category

Characteristics	Phase I Original population OR[1,2,4]	*p-value*[3]	Phase I Refresh population OR[1,2,5]	*p-value*[3]	Phase II population OR[1,2,6]	*p-value*[3]
Number of cases	366	N/A	156	N/A	209	N/A
Chi-square (p<)	18.96	N/S	15.57	N/S	23.36	N/S
Pseudo R2	0.05	N/A	0.10	N/A	0.11	N/A

NOTES: CMHCB = Care Management for High Cost Beneficiaries; OR = odds ratio; HCC = Hierarchical Condition Category; PBPM = per beneficiary per month.

[1] Beneficiaries had to have had some baseline eligibility and at least 3 months of eligibility during the Phase II demonstration period and have agreed to use the Health Buddy® device.

[2] Beneficiary counts weighted by fraction of eligible days = full-time equivalents

[3] * denotes statistical significance at the 5% level;** denotes statistical significance at the 1% level.

N/A means not applicable; N/S means not statistically significant.

[4] The baseline HCC score reference group is <0.71. The age reference group is 65-74 years. The PBPM reference group is < $356. The baseline Charlson score reference group is < 2.

[5] The baseline HCC score reference group is <0.76. The age reference group is 65-74 years. The PBPM reference group is < $358. The baseline Charlson score reference group is < 2.

[6] The baseline HCC score reference group is <1.55. The age reference group is 65-74 years. The PBPM reference group is < $474. The baseline Charlson score reference group is < 2.

Data Sources: RTI analysis of 2008-2011 Medicare enrollment, eligibility, claims and encounter data.

Programs: enctab3a enctab5a

3.4 Summary

For the Phase II Health Buddy® Program at Montefiore Demonstration, we found that Medicare beneficiaries age 85 and older and those who died or were institutionalized during the Phase II demonstration period were less likely to be long-term participants. At the same time, we observed that beneficiaries who were the sickest or predicted to be the most costly during the year prior to the start of Phase II were more likely to be long-term participants. Within the Phase I Original population, beneficiaries with high baseline PBPM costs and Charlson scores were more likely to participate, indicating that RBHC staff did attempt to engage the sicker Medicare beneficiaries. Similar results were found for the Phase I Refresh population – beneficiaries with medium and high baseline HCC scores were more likely to participate – and the Phase II population – beneficiaries with high baseline PBPMs costs were more likely to participate. These results suggest that the Phase II Health Buddy® Program at Montefiore Demonstration was successful at engaging the sicker and more costly beneficiaries in their Phase II program.

A cornerstone of the Phase II Health Buddy® Program at Montefiore Demonstration was the Health Buddy® device and interactions with care managers; however, nearly 80% of eligible beneficiaries never used the Health Buddy® device. Of the beneficiaries participating in the program and using the Health Buddy® device, the percentage of beneficiaries receiving at least one call from a care manager during the Phase II demonstration ranged from 85% (Phase II population) to 90% (Phase I Refresh population). Nearly 14% of Phase I beneficiaries received more than 20 contacts during this same time period. Outbound telephone contact was the most dominant form of contact. In our multivariate regression modeling of likelihood of being in a high contact versus low contact group for the Phase I Original population, we found that beneficiary characteristics and demonstration period acute care utilization were not indicators of being in the high contact category, but high baseline PBPMs increased the likelihood of being in the high contact group. The small sample sizes of Health Buddy® device users in the Phase I populations made it difficult to determine statistically significant differences. Among the Phase II population Health Buddy® device users, beneficiaries with high baseline HCC scores and a hospitalization during the intervention period were indicators of high contact, indicating that RBHC staff attempted to target the beneficiaries with more urgent health care needs.

CHAPTER 4
CLINICAL QUALITY PERFORMANCE

4.1 Introduction

RTI's analysis of quality of care focuses on measuring effectiveness of the Phase II Health Buddy® Program at Montefiore Demonstration by answering the following evaluation question:

- *Clinical Quality of Care:* Did the Phase II Health Buddy® Program at Montefiore Demonstration improve quality of care, as measured by improvement in the rates of beneficiaries receiving guideline concordant care?

Although improvement in the rate of receipt of guideline concordant care was not a performance metric in the Phase II Health Buddy® Program at Montefiore Demonstration, we felt that it was important from an evaluation perspective to examine whether more frequent contact with care managers and the educational programs within the Health Buddy® device motivated beneficiaries to increase compliance with evidence-based care guidelines.

In this chapter, we present analyses related to clinical quality performance during the Phase II Health Buddy® Program at Montefiore Demonstration by examining changes in the rate of receipt of seven evidence-based process-of-care measures during the demonstration, relative to a 12-month baseline period in both the intervention and comparison populations for the Phase I Original and Refresh populations and the Phase II population. Six of these measures pertain to beneficiaries with diabetes: rate of annual HbA1c testing, low-density lipoprotein cholesterol (LDL-C) screening, receipt of a retinal eye exam, medical attention for nephropathy, as well as the rate at which beneficiaries received all four of those measures, or none of those measures. Completion of a complete lipid profile will be used for beneficiaries with ischemic vascular disease (IVD).

Given the use an intent-to-treat (ITT) model and our difference-in-differences evaluation approach seven of our measures require information for the pre-demonstration and demonstration periods for both the intervention and comparison populations. Therefore, we selected measures that could be reliably calculated using Medicare administrative data. These data are available for both the intervention and comparison populations and do not require medical record abstraction or beneficiary self-report. Medical record data are not available to us for either the intervention or comparison populations, and beneficiary self-report data would only be available for the intervention beneficiaries who participated during the demonstration. Further, beneficiary self-report is subject to recall error and the willingness of beneficiaries to provide the information.

4.2 Methodology

We created the process-of-care measures for the12-month period immediately prior to the beginning of the Phase II demonstration period for the all three populations (the Phase II start date was June 1, 2009 for the Phase I Original and Refresh populations and December 1, 2009 for the Phase II population). These measures were also constructed for the last 12 months of the demonstration (months 14-25 for the Phase I Original and Refresh population and months 8-19

for the Phase II population). Only beneficiaries who had at least 1 day of eligibility in the baseline period and at least 3 months of eligibility in the Phase II demonstration period are included in the analysis of each measure. ***Table 4-1*** provides the number of beneficiaries who were included in the analyses of the quality of care measures, in total, and by two disease cohorts: diabetes and IVD.

Table 4-1
Number of beneficiaries included in analyses of guideline concordant care and acute care utilization for the Phase II Health Buddy® Program at Montefiore CMHCB Demonstration

Statistics	All	Diabetes	Ischemic vascular disease
Phase I Original beneficiaries			
Months 14-25			
Intervention			
Total number of beneficiaries	1,465	605	570
Full time equivalents[1]	1,458	602	568
Comparison			
Total number of beneficiaries	865	413	357
Full time equivalents[1]	854	406	353
Phase I Refresh beneficiaries			
Months 14-25			
Intervention			
Total number of beneficiaries	560	217	189
Full time equivalents[1]	554	214	186
Comparison			
Total number of beneficiaries	518	245	198
Full time equivalents[1]	510	240	195
Phase II beneficiaries			
Months 8-19			
Intervention			
Total number of beneficiaries	3,931	1,683	1,403
Full time equivalents[1]	3,896	1,662	1,388
Comparison			
Total number of beneficiaries	3,995	1,624	1,638
Full time equivalents[1]	3,968	1,612	1,628

NOTES: CMHCB = Care Management for High Cost Beneficiaries.

[1] Full Time Equivalent for the intervention group during the baseline period is the total number of beneficiaries weighted by their period of eligibility for the demonstration and propensity score weight.

SOURCE: RTI analysis of 2008-2011 Medicare enrollment, eligibility, claims and encounter data; Computer runs: basedx, gcc01, gcc02, gcctab, gcc_rob, gcctabx, gcctab1, ascs02a

Medicare claims for the baseline and intervention periods were only included during a beneficiary's period of eligibility. Once a beneficiary became ineligible, no claims were included for the remainder of the demonstration period. Rates per 100 beneficiaries are reported for the intervention and comparison groups for the 12-month baseline periods and for the demonstration periods. Two weights are used to adjust the quality of care analyses described above: the propensity weight and the eligibility weight. The final analytic weight is the product of these two weights in each time period. For each measure, the reported difference-in-differences (D-in-D) rate reflects the growth (or decline) in the intervention group's mean rate of receipt of care relative to the growth (or decline) in the comparison group's mean rate. A positive intervention effect for the guideline-concordant care measures occurred if the intervention group's mean rate either increased more, or declined less, than the comparison group's mean rate during the demonstration period. A negative intervention effect occurred if the intervention group's mean rate increased less, or declined more, than the comparison group's mean rate during the demonstration period.

Statistically testing the difference-in-differences rate of receipt of the measures was performed at the individual beneficiary level. The standard method for modeling a binary outcome, such as receiving an HbA1c test, is logistic regression. The experimental design for the CMHCB demonstration also requires that the variance of the estimates be properly adjusted for the repeated (pre- and post-) measures observed for each sample member within a nested experimental design. The Phase II Health Buddy® Program at Montefiore Demonstration design was based on two nested cohort samples of Medicare beneficiaries who were assigned to intervention and comparison groups. In addition, the product of the eligibility fraction ranging from 0 to 1 and the propensity weight was included as the weight to reflect the period of time during which the beneficiary met the Phase II Health Buddy® Program at Montefiore Demonstration eligibility criteria in the baseline and demonstration periods and to adjust for baseline differences in the comparison group. STATA SVY was used to fit the model with robust variance estimation.

Logistic regression produces an odds ratio for every predictor variable in the model; that is, an estimate of that variable's effect on the dependent variable after adjusting for the other variables (randomization factors) in the model. The odds ratio is greater than 1.0 when the presence of the variable is associated with an increased likelihood of receiving the service; an odds ratio less than 1.0 means that the variable is inversely associated with receiving the service. The statistical test determines whether the odds ratio is 1.0. We report the odds ratio associated with the D-in-D interaction term, or the test of the difference-in-differences of the rate, in addition to the odds ratio's associated *p-value* and 95% confidence level.

4.3 Findings

Process-of-care rates per 100 for the three Phase II Health Buddy® Program at Montefiore Demonstration populations are reported in ***Table 4-2***. We report the baseline and intervention period rates for the intervention and comparison groups as well as the difference-in-differences rates (baseline period intervention versus comparison rate difference minus intervention period intervention versus comparison rate difference). Positive difference-in-differences rates per 100 beneficiaries indicate that the intervention group's mean rate improved more than the comparison group's mean rate or the intervention group's mean rate declined at a

lower rate than the comparison group's mean rate. Negative difference-in-differences rates per 100 beneficiaries indicate that comparison group exhibited higher rates of growth or less of a decline, than the intervention group.

Table 4-2
Comparison of rates of guideline concordant care for the last 12 months of the Phase II Health Buddy® Program at Montefiore CMHCB Demonstration with rates for a 1-year period prior to the start of the Phase II Demonstration

Process of care measures	Rate per 100 Baseline I[1]	Rate per 100 Baseline C[1]	Rate per 100 Demo period I[1]	Rate per 100 Demo period C[1]	D-in-D Rate per 100	D-in-D OR	D-in-D *p-value*	D-in-D CI Low	D-in-D CI High
Phase I Original population									
Months 14-25									
Beneficiaries with diabetes[2]									
HbA1c test	90	91	89	91	-1.15	0.89	0.72	0.45	1.73
LDL-C test	87	86	85	85	-0.59	0.95	0.85	0.55	1.65
Eye Exam[3]	67	75	66	69	4.86	1.28	0.25	0.84	1.96
Nephropathy[3]	58	51	58	53	-2.13	0.92	0.67	0.62	1.36
All 4 measures	36	36	35	36	-1.42	0.94	0.76	0.63	1.41
None of the 4 measures	1	2	4	2	2.44	2.96	0.11	0.79	11.04
Beneficiaries with IVD[2]									
Lipid Panel	81	83	79	84	-2.82	0.83	0.46	0.51	1.36
Phase I Refresh population									
Months 14-25									
Beneficiaries with diabetes[2]									
HbA1c test	93	93	91	91	-0.16	0.98	0.98	0.36	2.67
LDL-C test	90	90	86	87	-0.51	0.98	0.96	0.42	2.29
Eye Exam[3]	64	72	63	70	1.20	1.06	0.83	0.60	1.90
Nephropathy[3]	53	55	51	59	-5.71	0.79	0.41	0.46	1.37
All 4 measures	32	40	35	40	3.63	1.18	0.57	0.67	2.07
None of the 4 measures	1	1	3	1	1.60	1.97	0.54	0.23	17.11
Beneficiaries with IVD[2]									
Lipid Panel	84	87	83	86	-0.99	0.94	0.88	0.42	2.12

(continued)

Table 4-2 (continued)
Comparison of rates of guideline concordant care for the last 12 months of the Phase II Health Buddy® Program at Montefiore CMHCB Demonstration with rates for a 1-year period prior to the start of the Phase II Demonstration

Process of care measures	Rate per 100 Baseline I[1]	Rate per 100 Baseline C[1]	Rate per 100 Demo period I[1]	Rate per 100 Demo period C[1]	D-in-D Rate per 100	D-in-D OR	D-in-D *p-value*	D-in-D CI Low	D-in-D CI High
Phase II population									
Months 8-19									
Beneficiaries with diabetes[2]									
HbA1c test	87	91	88	89	3.04	1.37	0.05	1.00	1.88
LDL-C test	87	89	86	85	2.91	1.29	0.09	0.96	1.74
Eye Exam[3]	62	68	61	68	-0.94	0.96	0.71	0.78	1.19
Nephropathy[3]	55	55	58	56	1.65	1.07	0.51	0.87	1.31
All 4 measures	33	37	34	37	0.53	1.03	0.81	0.83	1.26
None of the 4 measures	3	3	3	4	-1.39	0.63	0.11	0.35	1.12
Beneficiaries with IVD[2]									
Lipid Panel	84	85	81	82	-0.60	0.96	0.80	0.73	1.27

NOTES: CMHCB = Medicare Care Management for High Cost Beneficiaries; I = intervention population; C = comparison population; D-in-D = difference-in-differences; OR = odds ratio; CI = confidence interval; LDL-C = low-density lipoprotein cholesterol; IVD = ischemic vascular disease; CMO = care management organization.

[1] All rates are per 100 beneficiaries and are adjusted for periods of demonstration eligibility during the one-year period prior to the start of the demonstration and each set of months the Phase II Health Buddy® Program at Montefiore Demonstration was active. Rates are further weighted by the mean propensity score weight. Only beneficiaries who had at least 1 day of eligibility in the baseline period and at least 3 months of eligibility in the Phase II demonstration period are included in the analysis.

[2] Ischemic Vascular Disease and diabetes are defined using the National Qualify Forum definition.

[3] Specialty codes were not available on the baseline data for the Phase I Populations, so this criteria were not used in selecting claims for these measures.

SOURCE: RTI analysis of 2008-2011 Medicare enrollment, eligibility, claims and encounter data; Computer runs: basedx, gcc01, gcc02, gcc_rob, gcctabx, gcctab1, gcctab

At baseline, the Phase I Original population's intervention group with diabetes had individual measures of diabetes care with rates ranging from 58% for nephropathy screening to 90% for HbA1c testing. Only one-third of beneficiaries in this group received all 4 diabetes measures; however 99% of beneficiaries received at least one of the four measures. Most rates were similar for the Phase I Original population's comparison group at baseline, with the comparison group having higher rates of eye exams and lower rates of screening for nephropathy at baseline. Over the course of the demonstration period, the rates remained essentially unchanged; there was a modest reduction in rates within the intervention group. Not surprisingly, we observe only modest separation in the difference-in-differences rates with none

having statistical significance. For beneficiaries with ischemic vascular disease, the rate of lipid panel testing was similar between the intervention and comparison groups at baseline, around 80% with no statistically significant differences in growth rates observed.

At baseline, the Phase I Refresh population's intervention group had individual measures of diabetes care with rates ranging from 53% for nephropathy screening to 93% for HbA1c testing. Once again, we observe only one-third of beneficiaries in this group having received all 4 diabetes measures, with 99% receiving at least one of the four. The rates of eye exams and the receipt of all 4 measures were higher for the Phase I Refresh population's comparison group at baseline. Over the course of the demonstration period, the rates varied from baseline by no more than four percentage points. Rates for three of the diabetes measures in the comparison group declined over the course of the demonstration period. For the intervention groups, all individual diabetes measures declined during the demonstration period, while we observe an increase in the number of beneficiaries that received all four measures and that received none of the screening tests, which increased by three and two percentage points, respectively. Again, we observe only modest separation in the difference-in-differences rates, none of which are statistically significant. For ischemic vascular disease, the rate of lipid panel testing was similar for the intervention and comparison groups at baseline, 84% and 87%, respectively. Both groups' rates declined during the intervention period.

At baseline, the Phase II population's intervention group had individual measures of diabetes care with rates ranging from 55% for nephropathy screening to 87% for HbA1c and LDL-C testing. One-third of beneficiaries in this group received all 4 diabetes measures, with 97% receiving at least one of the four. The rates of 4 of the diabetes measures were higher for the Phase I Refresh population's comparison group at baseline. Over the course of the demonstration period, the rates varied from baseline by no more than four percentage points. Rates for HbA1c and LDL-C testing in the comparison group declined over the course of the demonstration period. For the intervention groups, LDL-C testing and retinal eye exams declined slightly during the demonstration period, while we observe an increase in the number of beneficiaries that received screening for nephropathy. The rate of receipt of HbA1c among the Phase II intervention beneficiaries increased by 1 percentage point while the rate of receipt among the comparison beneficiaries decreased 2 percentage points. Thus, the D-in-D change is 3 percentage points, which is a statistically significant positive intervention effect. There are no other statistically significant differences. For ischemic vascular disease, the rate of lipid panel testing was similar for the intervention and comparison groups at baseline, 84% and 85%, respectively. Both groups' rates declined during the intervention period.

4.4 Summary of Findings and Conclusion

In this chapter, we reported on RTI's assessment of the effect of the Phase II Health Buddy® Program at Montefiore Demonstration on quality of care. Specifically, we reported findings for the key research question: did the Phase II Health Buddy® Program at Montefiore Demonstration improve quality of care, as measured by improvement in the rates of beneficiaries receiving guideline concordant care? We find no evidence of systematic improvement in quality of care in the Phase II Health Buddy® Program at Montefiore Demonstration. For several of the diabetes measures we are likely observing a ceiling effect. However, there is considerable room for improvement for several of the other measures and for the composite measure that considers

receipt of all four diabetes measures. Only one measure, HbA1c, exhibited a statistically significant difference in the change in rate of receipt of evidence-based care between the intervention and comparison groups, and only for the Phase II population. Beneficiaries in the Phase II population intervention group had a 1 percentage point increase in the receipt of HbA1c with a 2 percentage point decrease in the comparison group. During the last year of its demonstration, we observe lower or very similar rates of adherence to the selected measures among its intervention beneficiaries relative to the comparison group beneficiaries for all measures. These findings suggest that improving or sustaining adherence to guideline concordant care in a cohort of ill Medicare FFS beneficiaries is challenging.

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CHAPTER 5
HEALTH OUTCOMES

5.1 Introduction

RTI's analysis of health outcomes focuses on answering the following two evaluation questions:

- Did the Phase II Health Buddy® Program at Montefiore Demonstration improve intermediate health outcomes by reducing acute hospitalizations, readmissions, or emergency room (ER) utilization?

- Did the Phase II Health Buddy® Program at Montefiore Demonstration improve health outcomes by decreasing mortality?

In this chapter, we present analyses related to intermediate clinical health outcomes by examining changes in the rate of hospitalizations, ER visits, and readmissions for the Phase II Health Buddy® Program at Montefiore Demonstration during the last 12 months of the demonstration period for the Phase I Original and Refresh populations and the Phase II population relative to a 12-month baseline period. We also examine differences in the rate of mortality between the intervention and comparison populations for all three cohorts during the entire Phase II demonstration period. For all analyses, we present the results separately for beneficiaries within the Phase I Original, Phase I Refresh, or Phase II populations.

5.2 Methodology

5.2.1 Rates of Hospitalizations and Emergency Room Visits

For Phase II, rates of hospitalization and ER visits were constructed for the 12-month period immediately prior to the Phase II demonstration program launch date (June 1, 2008 through May 31, 2009) and for months 14-25 of the demonstration for the Phase I Original and Refresh populations. For the Phase II population, these rates were constructed for the baseline period December 1, 2008 through November 30, 2009 (one year prior to this populations Phase II launch date of December 1, 2009) and for months 8-19 of the demonstration. We constructed rates of all-cause hospitalization and all-cause ER visits. We also created a utilization measure that includes 34 ambulatory care sensitive conditions (ACSC) as reasons for hospitalization— acute renal failure, altered mental status, anemia, angina, asthma, bacterial pneumonia, C. difficile, cellulitis, congestive heart failure, constipation/fecal impaction/obstipation, chronic obstructive pulmonary disease (COPD) and chronic bronchitis, dehydration/volume depletion, diabetes, diarrhea and gastroenteritis, falls and trauma, hypertension, hypoglycemia, hypokalemia, hyponatremia, hypotension, immunization/preventable conditions, influenza, ischemic stroke, nutritional deficiencies, perforated or bleeding ulcer, pyelonephritis, ruptured appendix, seizures, septicemia, severe ear, nose, and throat infections, skin ulcers, tuberculosis, urinary tract infection (UTI), weight loss/failure to thrive— identified using the primary diagnosis on the claim, and generated an hospitalization rate and an ER visit rate based on all ACSCs. Only claims that occurred during periods of eligibility were included in the utilization

measures, and only beneficiaries who had at least 3 months of eligibility during the Phase II demonstration period are included in these analyses.

Table 4-1 in ***Chapter 4*** displays the number of beneficiaries who were included in these utilization analyses. All-cause and ACSC rates of hospitalization and ER visits per 1,000 beneficiaries are reported for the intervention and comparison groups for the baseline and intervention periods. Two weights are used to adjust the utilization analyses described above: the propensity score weight as described in ***Section 2.3.2*** and the eligibility weight as described in ***Section 2.2.2***. The final analytic weight is the product of these two weights in each time period. For each measure, the difference-in-differences (D-in-D) rate is reported and reflects the decline (or growth) in the intervention group's mean rate of utilization relative to the decline (or growth) in the comparison group's mean rate. A positive intervention effect for the acute care utilization measures occurs if the intervention group's mean rate decreased more, or increased less, than the comparison group's mean rate during the demonstration period. A negative intervention effect occurs if the intervention group's mean rate declined less, or grew more, than the comparison group's mean rate during the demonstration period.

We performed statistical testing of the change in the utilization rates at the individual beneficiary level. The distributional properties of the data led us to select a negative binomial generalized linear model, which accounts for the presence of beneficiaries with no hospitalizations or ER visits in either time period, as well as heterogeneity in rates of acute care service use. As with the process-of-care measures, STATA SVY was used to fit the model with robust variance estimation to adjust for the repeated (pre- and post-) measures and multiple hospitalizations or ER visits observed for sample members within a nested experimental design. In addition, the product of the eligibility fraction ranging from 0 to 1 and the propensity weight was included as the weight to reflect the period of time during which the beneficiary met the Phase II Health Buddy® Program at Montefiore Demonstration eligibility criteria in the baseline and demonstration periods and to adjust for potential baseline differences in the comparison group.

Negative binomial regression models produce an incidence rate ratio (IRR), which is an estimate of that intervention's effect on the outcome. An IRR greater than 1.0 is associated with an increased likelihood of acute care utilization, and an IRR less than 1.0 is associated with a decreased likelihood of acute care utilization. We report the IRR associated with the D-in-D rates of hospitalizations and ER visits in addition to the IRR's associated *p-value* and 95% confidence interval.

5.2.2 Rates of 90-Day Readmissions

We estimated the percent of beneficiaries with at least one readmission within 90 days of discharge and the readmission rate per 1,000 beneficiaries with an index hospitalization. Readmissions are identified for index hospitalizations that occurred during 12-month spans in both the baseline and demonstration periods. For the baseline period, we included index hospitalizations in the 12-month period immediately prior to the Phase II go-live date for all three populations' demonstration period. Therefore, 90-day readmissions for baseline period hospitalizations were counted through the first 3 months of the demonstration period. The intervention period for the Phase I Original and Refresh population examined admissions during

the periods of months 11 through 22 and included readmissions through months 25. For the Phase II population, months 5 through 16 were used to identify index admissions and included readmissions through month 19.

For all hospitalizations, we calculated readmissions for any diagnosis (all-cause readmissions). For the ACSC conditions, a subset of the hospitalizations, we calculated readmissions with a primary diagnosis in the same ACSC category (same cause readmissions). Because readmissions can only occur if there is an initial hospitalization, hospitalization rates can influence readmission rates. To provide context for readmission rate estimates, we estimated the percent of beneficiaries with a hospitalization for any diagnosis and the percent with a hospitalization for one of the 34 ACSC conditions.

Readmission estimates were weighted by the fraction of days eligible until a readmission occurred or up to 90 days following an index hospitalization discharge, if there were no readmission within 90 days. For beneficiaries with more than one index hospitalization, the fraction was calculated by summing eligible days following each hospitalization. To equalize the impact of differences in days of eligibility on readmission rates per 1,000 beneficiaries, counts of hospitalizations were inflated by the fraction of days eligible following index hospitalizations. Propensity score weights were also applied.

The percent of beneficiaries with hospitalization, the percent with a readmission, and the readmission rate per 1,000 beneficiaries with an index hospitalization are presented for the intervention and comparison groups during both the baseline and demonstration periods. For each measure, we compare the change between the baseline and demonstration periods for the intervention group relative to the comparison group, and test for the significance of the D-in-D between the groups. If the Phase II Health Buddy® Program at Montefiore Demonstration reduced hospitalizations and readmissions, we expect to observe a negative D-in-D, reflecting greater reductions (or smaller increases) in the intervention group relative to the comparison group.

Logistic regression was used to estimate the likelihood of having a hospitalization, and a negative binomial generalized linear model was used for readmission rate estimates. STATA SVY was used to fit the model with robust variance estimation. Regression models were weighted by the eligibility fractions described above. We report the odds ratio (OR) from the logistic regressions and the IRR from the negative binomial regressions of the D-in-D test, along with the associated *p-value* and 95% confidence interval. ORs and IRRs less than 1.0 are associated with a negative D-in-D, indicating that the Phase II Health Buddy® Program at Montefiore Demonstration reduced hospitalizations or readmissions for the intervention group relative to the comparison or slowed the growth in rates.

5.2.3 Mortality

Another outcome metric in this evaluation is mortality. We constructed mortality rates per 100 beneficiaries and compared differences in mortality rates between all three populations' intervention and comparison groups between the Phase II go-live dates and the end of the Phase II demonstration period. We also examined mortality rates for beneficiaries with and without the Health Buddy® device. Statistical comparison of the mortality rates was made using a *t*-test of

differences in mean rates between the intervention and comparison groups and the propensity score weights described in ***Section 2.3.2***. We further explored the potential impact of the intervention on mortality by estimating a multivariate Cox proportional hazard model of survival. Date of death was obtained from the Medicare Enrollment Data Base (EDB). We estimated the survival model comparing all intervention and comparison group beneficiaries using a propensity score weight to adjust for any potential differences in baseline characteristics. Further, we estimated a survival model comparing only those beneficiaries in the intervention group that agreed to use the Health Buddy® device and completed at least one survey with the full comparison group and a revised propensity score weight aligning the baseline characteristics of the full comparison group to the Health Buddy® device users within the intervention group. Because of small numbers of Health Buddy® device users, we pooled across the three cohorts and estimate a single survival model with additional covariates to reflect the cohort to which the beneficiaries belong and use of the device.

5.3 Findings

5.3.1 Rates of Hospitalizations and Emergency Room Visits

Hospitalization and ER visit rates per 1,000 for beneficiaries in all three populations for the year prior to go-live and the Phase II Demonstration periods are presented in ***Table 5-1***. Rates of hospitalization and ER visits are presented for all causes and for a subset of ACSCs. Next to the utilization rate columns are the D-in-D rates of change observed between the baseline period and the demonstration period for the intervention and comparison groups. Negative D-in-D rates indicate that the intervention group's mean rate of hospitalization or ER visits declined more, or grew more slowly, than the comparison group's mean hospitalization or ER visit rates. Positive D-in-D rates indicate that the comparison group exhibited either lower rates of growth, or a greater rate of decline, for hospitalization or ER visits than the intervention group. The last four columns contain the IRR, its respective statistical level of significance (*pvalue*) as well as the high and low 95% confidence interval thresholds for the IRR.

Not unexpectedly, the baseline rates of hospitalization and ER visits were high in the Phase I Original intervention and comparison populations. The baseline rate of all-cause hospitalization was 639 per 1,000 Phase I Original intervention group beneficiaries. The baseline rate of all-cause ER visits was 883 per 1,000 Phase I Original intervention beneficiaries. The ACSC reasons for hospitalization combined accounted for over 40 percent of all-cause hospitalizations and one-third of all-cause ER visits. Thus, Medicare FFS beneficiaries in the program were being treated in acute care settings for reasons other than prevalent chronic medical conditions such as heart failure, diabetes, and COPD, or prevalent acute medical conditions such as pneumonia.

The rates of all-cause and ACSC hospitalization and ER visits increased between the baseline and demonstration periods for both the Phase I Original intervention and comparison beneficiaries. The D-in-D is negative for the all-cause hospitalization rate indicating that the rate for the intervention group grew more slowly than the comparison group. The ACSC hospitalizations and both ER rates had a positive D-in-D value, indicating a faster increase in rates for the intervention group than the comparison group. None of the differences are statistically significant.

Hospitalization and ER visits rates per 1,000 Phase I Refresh beneficiaries are also presented in ***Table 5-1***. We observe the same high rates of baseline utilization. In contrast to growth patterns observed within the Phase I Original population, we observe a slower rate of growth for all four rates of hospitalizations and ER visits within the intervention group compared with the comparison group. However, none of the differences are statistically significant.

Lastly, ***Table 5-1*** presents hospitalization and ER visits rates per 1,000 Phase II beneficiaries. Once again, we have the intervention group shows a slower rate of growth for all four utilization rates, but the negative D-in-D rates are much lower than those for the Phase I Refresh population and are not statistically significant.

Utilization rates for users of the Health Buddy® device versus the comparison group were also calculated (not shown). The comparison group was adjusted for any potential baseline differences using the characteristics of the Health Buddy® device users. No statistically significant results were found between Health Buddy® device users and the propensity score adjusted comparison groups.

Table 5-1
Comparison of rates of utilization for the last 12 months of the Phase II Health Buddy® Program at Montefiore CMHCB Demonstration with rates of utilization for a 1-year period prior to the start of the Phase II Demonstration

Utilization	Baseline rate per 1,000 I [1,2,3]	Baseline rate per 1,000 C[1,2,3]	Demo period rate per 1,000 I[1,2,3]	Demo period rate per 1,000 C[1,2,3]	D-in-D	IRR[4]	*p-value*	Low CI	High CI
Phase I Original									
Hospitalizations									
All cause	639	639	903	961	-58	0.94	0.62	0.73	1.21
All ACSCs[5]	272	282	502	492	21	1.06	0.71	0.77	1.46
ER/Obs visits									
All cause	883	916	1,229	1,241	21	1.03	0.82	0.82	1.29
All ACSCs[5]	297	366	533	495	107	1.33	0.06	0.99	1.78
Phase I Refresh									
Hospitalizations									
All cause	605	604	771	918	-148	0.84	0.28	0.61	1.15
All ACSCs[5]	269	217	357	426	-122	0.67	0.07	0.44	1.03
ER/Obs visits									
All cause	910	894	1,125	1,170	-61	0.94	0.69	0.71	1.25
All ACSCs[5]	294	321	410	443	-6	1.01	0.96	0.69	1.49

(continued)

Table 5-1 (continued)
Comparison of rates of utilization for the last 12 months of the Phase II Health Buddy® Program at Montefiore CMHCB Demonstration with rates of utilization for a 1-year period prior to the start of the Phase II Demonstration

Utilization	Baseline rate per 1,000 I [1,2,3]	Baseline rate per 1,000 C[1,2,3]	Demo period rate per 1,000 I[1,2,3]	Demo period rate per 1,000 C[1,2,3]	D-in-D	IRR[4]	*p-value*	Low CI	High CI
Phase II Population									
Hospitalizations									
All cause	783	735	849	831	-31	0.96	0.45	0.86	1.07
All ACSCs[5]	332	279	428	376	-1	0.96	0.59	0.82	1.12
ER/Obs visits									
All cause	1,070	975	1,218	1,124	-0.4	0.99	0.82	0.89	1.10
All ACSCs[5]	376	335	476	437	-3	0.97	0.67	0.84	1.12

NOTES: CMHCB = Medicare Care Management for High Cost Beneficiaries; I= intervention population; C = comparison population; D-in-D = difference-in-differences; IRR = incidence rate ratio; CI = confidence interval; ACSC = ambulatory care sensitive condition; ER/Obs = emergency room visits, including observation bed stays.

[1] The baseline period is the one-year period prior to the go-live date of the Phase II Health Buddy® Program at Montefiore Demonstration.

[2] Rates are per 1,000 beneficiaries adjusted for periods of Phase II Health Buddy® Program at Montefiore Demonstration eligibility for the 1-year period prior to the start of the demonstration and for Phase II Health Buddy® Program at Montefiore CMHCB Demonstration eligibility during the intervention period. Rates are further weighted by the mean propensity score weight.

[3] Only beneficiaries who had at least 1 day of eligibility in the baseline period and at least 3 months of eligibility in the Phase II demonstration period are included in the analysis.

[4] Statistical testing of the difference-in-differences is conducted in STATA using negative binomial regression for rates/1,000 beneficiaries with robust variance estimation. The IRR is reported for negative binomial regressions. The *p-value* and confidence interval is reported for the IRRs.

[5] The 34 ambulatory care sensitive conditions are as follows: Acute renal failure, Altered mental status, Anemia, Angina, Asthma, Bacterial Pneumonia, C. Difficile, Cellulitis, Congestive heart failure, Constipation/fecal impaction/obstipation, Chronic obstructive pulmonary disease (COPD) and Chronic bronchitis, Dehydration/volume depletion, Diabetes, Diarrhea and gastroenteritis, Falls and trauma, Hypertension, Hypoglycemia, Hypokalemia, Hyponatremia, Hypotension, Immunization/Preventable Conditions, Influenza, Ischemic Stroke, Nutritional deficiencies, Perforated or Bleeding Ulcer, Pyelonephritis, Ruptured Appendix, Seizures, Septicemia, Severe Ear, Nose, and Throat Infections, Skin ulcers, Tuberculosis, Urinary Tract Infection (UTI), Weight Loss/Failure to thrive.

SOURCE: RTI analysis of 2008-2011 Medicare enrollment, eligibility, claims and encounter data;

Computer runs: acsc01a acsc02a acsctab acsc acsctab1

5.3.2 Rates of 90-Day Readmissions

Table 5-2 displays the total number of Phase I Original and Refresh and Phase II population beneficiaries included in the readmission analyses. ***Table 5-3*** displays the percent of all three populations' beneficiaries with a hospitalization, the percent of beneficiaries with readmission within 90 days, and the rate of 90-day readmission per 1,000 beneficiaries with an index hospitalization. Data are displayed for all-cause hospitalizations and readmissions, and ACSC hospitalizations and readmissions.

In general, we observe a pattern of growth in the percent of beneficiaries with a hospitalization and the rate of readmission for all causes and for ambulatory care sensitive conditions during the demonstration period for both the intervention and comparison groups. This indicates that the rate of readmission among the beneficiaries readmitted is growing during the demonstration period likely signaling deterioration in health status. For all three populations, the rate of growth for the intervention group ACSC same-cause readmissions was slower than for the comparison group. However, the all-cause readmission rates grew faster for the intervention group with the exception of the Phase I Original population. None of these results are statistically significant. When comparing differences in the rates of growth between the intervention and comparison groups, there is generally a pattern of higher rates of growth within the intervention group. One noted exception is for ACSC same-cause readmissions for the Phase I Refresh group. The rate declined slightly during the demonstration period for the intervention group while it increased for the comparison group. This result is also not statistically significant.

Table 5-2
Number of beneficiaries included in analysis of readmissions for the Health Buddy® Program at Montefiore CMHCB Demonstration

Counts of beneficiaries	Intervention	Comparison
Phase I Original – months 11-22		
Total number of beneficiaries	1,518	905
Full time equivalents[1]	1,511	901
Phase I Refresh – months 11-22		
Total number of beneficiaries	580	542
Full time equivalents[1]	573	538
Phase II population – months 5-16		
Total number of beneficiaries	4,060	4,103
Full time equivalents[1]	4,023	4,074

NOTES: CMHCB = Medicare Care Management for High Cost Beneficiaries.

[1] Full Time Equivalent for the intervention group during the baseline period is the total number of beneficiaries weighted by their period of eligibility for the demonstration and by the mean propensity score weight.

SOURCE: RTI analysis of 2008-2011 Medicare enrollment, eligibility, claims and encounter data; Computer runs: readm01a readmtab readm readmtab readmtab1

Table 5-3
Change in 90-day readmission[1] rates between the year prior to the Phase II Health Buddy® Program at Montefiore CMHCB Demonstration and the last 12 months of the demonstration

Utilization	Baseline rate per 1,000[1,2,3] I	Baseline rate per 1,000[1,2,3] C	Demo period rate per 1,000[1,2,3] I	Demo period rate per 1,000[1,2,3] C	D-in-D	OR/IRR[4]	*p-value*	Low CI	High CI
Phase I Original									
Hospitalizations									
Percent with hospitalization	35	36	39	39	1	1.02	0.86	0.80	1.31
Percent with ACSC hospitalization[5]	19	20	26	24	3	1.22	0.17	0.92	1.63
All-cause 90-day readmission									
Percent with readmission	33	35	43	40	4	1.19	0.40	0.79	1.77
Readmission rate / 1,000	644	714	999	1,111	-43	1.00	0.98	0.68	1.45
ACSC same-cause 90-day readmission[5]									
Percent with readmission	9	8	13	13	-1	0.90	0.81	0.39	2.09
Readmission rate / 1,000	125	119	196	246	-57	0.76	0.54	0.31	1.86
Phase I Refresh									
Hospitalizations									
Percent with hospitalization	33	34	37	41	-3	0.88	0.47	0.62	1.25
Percent with ACSC hospitalization[5]	18	17	22	23	-2	0.86	0.47	0.56	1.31
All-cause 90-day readmission									
Percent with readmission	35	36	44	40	6	1.26	0.44	0.71	2.24
Readmission rate / 1,000	687	761	874	835	112	1.16	0.58	0.69	1.94
ACSC same-cause 90-day readmission[5]									
Percent with readmission	8	3	11	10	-4	0.35	0.23	0.06	1.91
Readmission rate / 1,000	134	88	127	176	-95	0.47	0.32	0.11	2.06
Phase II population									
Hospitalizations									
Percent with hospitalization	42	40	38	37	-1	0.96	0.55	0.85	1.09
Percent with ACSC hospitalization[5]	22	20	22	20	1	1.04	0.58	0.90	1.22
All-cause 90-day readmission									
Percent with readmission	37	37	42	41	1	1.06	0.55	0.87	1.30
Readmission rate / 1,000	732	704	1,001	929	45	1.04	0.69	0.87	1.24
ACSC same-cause 90-day readmission[5]									
Percent with readmission	13	10	14	14	-3	0.76	0.20	0.51	1.15
Readmission rate / 1,000	179	137	231	219	-29	0.81	0.35	0.52	1.25

(continued)

Table 5-3 (continued)
Change in 90-day readmission[1] rates between the year prior to the Phase II Health Buddy® Program at Montefiore CMHCB Demonstration and the last 12 months of the demonstration

NOTES: CMHCB = Medicare Care Management for High Cost Beneficiaries; I= intervention population; C = comparison population; D-in-D = difference-in-differences; OR = odds ratio; IRR = incidence rate ratio; CI = confidence interval; ACSC = ambulatory care sensitive condition.

[1] Readmissions are defined as hospitalizations that occur within 90 days after the discharge date of an index hospitalization.

[2] Rates are per 1,000 beneficiaries adjusted for periods of CMHCB program eligibility for the one-year period prior to the start of the demonstration and for CMHCB program eligibility during the demonstration period. Rates are further weighted by the mean propensity score weight.

[3] Only beneficiaries who had at least 1 day of eligibility in the baseline period and at least 3 months of eligibility in the Phase II demonstration period are included in the analysis.

[4] Statistical testing of the difference-in-differences is conducted in STATA using logistic regression for percentages and negative binomial regression for rates/1,000 beneficiaries. Robust variance estimation is used for both logistic and negative binomial regressions. The OR is reported for logistic regressions; the IRR is reported for negative binomial regressions. The *p-value* and confidence interval is reported for ORs and IRRs.

[5] The 10 ambulatory care sensitive conditions are as follows: Acute renal failure, Altered mental status, Anemia, Angina, Asthma, Bacterial Pneumonia, C. Difficile, Cellulitis, Congestive heart failure, Constipation/fecal impaction/obstipation, Chronic obstructive pulmonary disease (COPD) and Chronic bronchitis, Dehydration/volume depletion, Diabetes, Diarrhea and gastroenteritis, Falls and trauma, Hypertension, Hypoglycemia, Hypokalemia, Hyponatremia, Hypotension, Immunization/Preventable Conditions, Influenza, Ischemic Stroke, Nutritional deficiencies, Perforated or Bleeding Ulcer, Pyelonephritis, Ruptured Appendix, Seizures, Septicemia, Severe Ear, Nose, and Throat Infections, Skin ulcers, Tuberculosis, Urinary tract infection (UTI), Weight Loss/Failure to thrive.

SOURCE: RTI analysis of Medicare enrollment, eligibility, claims and intervention data; Computer runs: readm01a readm02 readmtab readmtab1

5.3.3 Mortality

Mortality rates for intervention and comparison groups for the three Phase II Health Buddy® Program at Montefiore Demonstration cohorts are displayed in ***Table 5-4.*** Over the Phase II demonstration period, 16% of the Phase I Original beneficiaries died in both the intervention and the propensity score adjusted comparison groups. Slightly lower percentages of beneficiaries died during the Phase II demonstration period in the Phase I Refresh population (14% and 12% for the intervention and comparison groups, respectively). No statistically significant differences in mortality rates for either of the Phase I Populations were observed. The percentage of beneficiaries in the Phase II population that died was about one-half that of the Phase I Original population and the rate of intervention deaths was 1.2 percentage points higher than the rate for the comparison group. This small difference is statistically significant.

Table 5-4
Mortality rates during the Phase II Health Buddy® Program at Montefiore CMHCB Demonstration

Description	Intervention number of deaths	Percent	Comparison number of deaths[1]	Percent	Difference	*p-value*
Phase I Original population (25 months)	265	15.7	165	16.3	-0.6	0.70
Phase I Refresh population (25 months)	92	14.2	72	12.0	2.2	0.26
Phase II population (19 months)	332	8.0	289	6.9	1.2	0.05

NOTES: CMHCB = Care Management for High Cost Beneficiaries.

[1]Comparison group mean adjusted by beneficiary propensity score weight.

SOURCE: RTI analysis of Medicare enrollment, eligibility, and intervention data; Computer runs: mortalitya.sas, mortality2(3).sas

We further explored the rates of mortality in both the original and comparison populations by estimating a propensity score weighted multivariate Cox proportional hazard model of survival. ***Table 5-5*** displays three Cox Proportional Hazard multivariate models of survival for each of the three Phase II demonstration cohorts. The censoring variable is death and the survival model includes a dichotomous variable for intervention group status (=1 for intervention group beneficiaries and =0 for comparison group beneficiaries). To further guard against any remaining imbalances between the intervention and comparison group beneficiaries, as well as better isolating demonstration effects, we also include beneficiary baseline demographic and health status characteristics and baseline PBPM Medicare costs in the

regression specifications. These are the same variables that were used to estimate the propensity score model. A combination of the two approaches is doubly robust to model misspecification (Jaen et al., 2010; Lunceford & Davidian, 2004; Robins & Rotnitzky, 1995). The hazard ratios and associated *p-values* are displayed for all three sets of the models' independent variables. The hazard ratio can be interpreted as the odds that an individual in the group with the higher hazard reaches the endpoint first, and vice versa. In our case, the endpoint is death.

In each of the three survival models, the intervention variable has a hazard ratio of ranging from 0.937 to 1.135 and none of these hazard ratios are statistically significant implying no survival advantage or disadvantage to the intervention group for any of the three cohorts. Thus, after controlling for additional baseline characteristics, we no longer observe a statistically significant difference for the Phase II population. In general, we observe that beneficiaries who are age 85 and above and with high baseline HCC risk scores are far more likely to die that those without these characteristics.

Table 5-5
Propensity score weighted multivariate Cox proportional hazard survival models for the Phase II Health Buddy® Program at Montefiore CMHCB Demonstration

Characteristics	Phase I Original cohort Hazard ratio	*p-value*	Phase I Refresh cohort Hazard ratio	*p-value*	Phase II cohort Hazard ratio	*p-value*
Intervention	0.937	0.47	1.135	0.37	1.024	0.73
Age <65	1.105	0.96	1.103	0.97	1.015	0.03
Age 75-84	1.003	0.09	1.002	0.33	1.002	0.01
Age ≥ 85	1.009	0.00	1.011	0.00	1.011	0.00
Charlson Index Score	1.043	0.03	1.036	0.26	1.066	0.00
Baseline PBPM Cost	1.000	0.30	1.000	0.00	1.000	0.00
Baseline HCC score	1.268	0.00	1.203	0.04	1.231	0.00
Medicaid	0.999	0.44	0.998	0.20	0.999	0.17
Disability Original Reason	0.898	0.95	0.904	0.97	0.984	0.02
White	1.003	0.01	1.001	0.46	1.000	0.50
Female	1.000	0.94	0.996	0.00	0.998	0.00
Institutionalized	1.009	0.00	1.002	0.56	1.006	0.00

NOTES: Only beneficiaries who had at least 1 day of eligibility in the baseline period and at least 3 months of eligibility in the Phase II demonstration period are included in the analysis.
HCC = Hierarchical Condition Category; PBPM = per beneficiary per month.

The age reference group is 65-74 years.

Program: Dietab3v2, January 2013.

We further explored the mortality rates among intervention beneficiaries that used the Health Buddy® device and the full comparison groups using propensity score weights derived to balance beneficiary characteristics of the full comparison group to the Health Buddy® device users in the intervention group (***Table 5-6)***. Comparison group beneficiaries had higher rates of mortality that were statistically significant for the Phase I Refresh population, indicating that the interventions that beneficiaries received through the use of the device did improve health outcomes in terms of mortality.

Table 5-6
Mortality rates by the utilization of the Health Buddy® Device during the Phase II Health Buddy® Program at Montefiore CMHCB Demonstration

Description	Health Buddy® device	Percent	Comparison Group	Percent	Difference	*p-value*
Phase I Original population (25 months)						
Number of beneficiaries	366	21.6	220	100.0	N/A	N/A
Number of deaths	40	10.9	29	13.1	-2.2	0.43
Phase I Refresh population (25 months)						
Number of beneficiaries	156	24.0	142	100.0	N/A	N/A
Number of deaths	6	3.9	17	12.1	-8.2	0.00
Phase II population (19 months)						
Number of beneficiaries	877	21.3	892	100.0	N/A	N/A
Number of deaths	43	4.9	60	6.7	-1.8	0.11

NOTES: CMHCB = Care Management for High Cost Beneficiaries.

Only beneficiaries who had at least 1 day of eligibility in the baseline period and at least 3 months of eligibility in the Phase II demonstration period are included in the analysis.

SOURCE: RTI analysis of Medicare enrollment, eligibility, claims and intervention data; Computer runs: mortality.sas, mortality2v4.sas

However, the sample sizes for the device users are quite small. Therefore, we estimated a propensity score weighted multivariate Cox Proportional Hazard model of survival pooling across all three cohorts of comparison beneficiaries and Health Buddy® device users in the intervention group. The model is expanded to include additional covariates to reflect the cohort to which the beneficiaries belong (Phase I Original or refresh; the Phase II cohort is the reference group) and use of the device within the intervention group. The propensity score weights used in

the survival model were derived to balance beneficiary characteristics of the full comparison group to the Health Buddy® device users in the intervention group with all three groups pooled.

In ***Table 5-7,*** we observe that the Health Buddy® device variable has a hazard ratio of 0.610 implying a survival advantage to the intervention group beneficiaries that used the Health Buddy® device and completed at least one survey. It is statistically significant at the 0.0001 level.

Table 5-7
Propensity score weighted multivariate Cox proportional hazard survival model for the Phase II Health Buddy® Program at Montefiore CMHCB Demonstration: Health Buddy® device users versus comparison group beneficiaries

Characteristics	Hazard ratio	*p-value*
Device	0.610	0.0001
Phase I Original cohort	1.629	0.0025
Phase I Refresh cohort	1.404	0.1020
Age <65	1.016	0.2527
Age 75-84	1.002	0.1803
Age > 85	1.011	<.0001
Charlson Index Score	1.043	0.1150
Baseline PBPM Cost	1.000	0.4949
Baseline HCC score	1.323	<.0001
Medicaid	0.998	0.1577
Disability Original Reason	0.984	0.2240
White	1.000	0.9470
Female	0.999	0.4044
Institutionalized	1.010	0.0346

NOTES: Only beneficiaries who had at least 1 day of eligibility in the baseline period and at least 3 months of eligibility in the Phase II demonstration period are included in the analysis. HCC = Hierarchical Condition Category; PBPM = per beneficiary per month.

The population reference group is the Phase II population. The age reference group is 65-74 years.

Program: Dietab3v3, January 2013.

5.4 Conclusions

RTI's analysis of health outcomes focuses on measuring effectiveness of the Phase II Health Buddy® Program at Montefiore Demonstration intervention by answering the following evaluation questions:

- Did the Phase II Health Buddy® Program at Montefiore Demonstration improve intermediate health outcomes by reducing acute hospitalizations, readmissions, and ER utilization?

- Did the Phase II Health Buddy® Program at Montefiore Demonstration improve health outcomes by decreasing mortality?

During the course of the Phase II Health Buddy® Program at Montefiore Demonstration, in general we observed increasing rates of all-cause and ACSC hospitalizations, ER visits, and 90-day readmissions in both the intervention and comparison groups and for all three populations. Out of 30 acute care utilization comparisons, we observe no statistically significant differences in the rates of growth. However, we do observe a trend toward lower rates of growth within the Phase II intervention groups for two-thirds of the acute care utilization measures.

We also do not observe a statistically significant differential rate of mortality between the intervention and comparison groups for the Phase I Original and Refresh populations. However, for the Phase II population, over the 19-month demonstration period 8% of the intervention group beneficiaries died while 7% of the comparison group beneficiaries died, which was found to be statistically significant. However, in a multivariate survival model, whereby we control for potential imbalances in beneficiary characteristics at the start of the demonstration period between the intervention and comparison group, the observed survival benefit for the Phase II comparison group relative to the intervention group no longer existed.

In stark contrast, when we examined mortality for intervention beneficiaries who used the Health Buddy® device relative to the full comparison group, we observed a statistically significant survival benefit among Health Buddy® device users in the multivariate survival model; a hazard ratio of 0.615. This finding is consistent with findings in our evaluation of the Phase I and Phase II Health Buddy® West program.

CHAPTER 6
FINANCIAL OUTCOMES

6.1 Introduction

In this section, we present final evaluation findings on levels and trends in Medicare costs for the year prior to the go-live date and over all of the Phase II months that the Health Buddy® Program at Montefiore Demonstration was in operation. The evaluation questions are:

- How variable are per beneficiary per month (PBPM) costs in the intervention and comparison populations?
- What was the minimally detectable savings rate given the variability in beneficiary PBPM costs?
- For the three Phase II cohorts, what were the Medicare costs per beneficiary per month (PBPM) in the base year compared with the demonstration period for the intervention and the comparison cohorts?
- What were the levels and trends in PBPM costs for intervention group participants and nonparticipants? Did nonparticipation, alone, materially reduce the intervention's overall cost savings?
- How did Medicare savings in the three Phase II cohorts compare with the fees that were paid out? Did the Phase II Health Buddy® Program at Montefiore Demonstration meet budget neutrality using RTI's methodology?
- How balanced were the intervention and comparison group samples on patient characteristics prior to the demonstration's start date? How important were any differences to the estimate of savings?
- Did users of the Health Buddy® device show cost savings when compared with a matched group of non-users?

The cost analyses presented in this section differ from those conducted by Actuarial Research Corporation (ARC) for financial reconciliation under contract to CMS. ARC determined savings based on the demonstration's terms and conditions negotiated between CMS and the Phase II Health Buddy® Program at Montefiore Demonstration. RTI's estimation of savings differs in that

- savings rates between intervention and comparison groups are first determined at the beneficiary level and then tested using statistical confidence intervals,
- beneficiary PBPM costs are not trimmed using a 1% outlier dollar threshold, and
- both base year and demonstration period PBPM costs are weighted by each beneficiary's fraction of eligible days during the demonstration period.

A more detailed explanation and justification for these differences is provided in ***Section 6.3***.

The rest of this chapter has six sections. The next two sections **6.2 and 6.3** describe our data sources, variable construction, and analytic methods. ***Section 6.4*** presents our primary findings on trends in PBPM costs between base and demonstration periods. ***Section 6.5*** shows PBPM savings in relation to average monthly fees and whether the Phase II Health Buddy® Program at Montefiore Demonstration achieved budget neutrality using RTI's costing methods. ***Section 6.6*** uses multivariate regression methods to control for any imbalances between intervention and comparison samples that might affect t-tests of mean differences in PBPM growth rates. Tests are conducted between the full intervention and comparison groups as well as between device users and a matched comparison group. The chapter concludes in ***Section 6.7*** with a summary of key findings.

6.2 Data and Key Variables

6.2.1 Sample Frame and Data

RTI's analyses of PBPM costs were based on Medicare Parts A and B claims for all eligible beneficiaries in the Phase II Health Buddy® Program at Montefiore Demonstration intervention and comparison groups. Three cohorts were analyzed:

1. The Phase I Original cohort starting Phase II on June 1, 2009 of Phase II.
2. The Phase I Refresh cohort that started Phase II on the same date.
3. The Phase II cohort that started on December 1, 2009.

Performance in all three cohorts was evaluated through June 30, 2011.

We restricted all analyses to beneficiaries who were alive at the start date of the Phase II demonstration. Claims costs were accumulated until a beneficiary died or otherwise became ineligible (e.g., joined a managed care plan). Claims represented utilization *anywhere* in the United States, not just the target area of the Phase II MGH CMP Demonstration. Medicare costs were based on eligible claims submitted during the full demonstration period plus 12 months prior to the start date. A 9-month "run-out" period after the demonstration ended assured a complete set of costs.

6.2.2 Constructing PBPM costs

All financial analyses were conducted on a PBPM basis, or the ratio of eligible Medicare costs to eligible months with the beneficiary as the unit of analysis. The baseline period is defined as 365 days (or 1 year) prior to each Phase II cohort's start date. The Phase I Original and Refresh cohort demonstration period spanned 25 months, or 761 days (25 months × 30.42 days/month) after the start date. The Phase II cohort spanned 19 months, or 578 days.

Medicare program costs in the numerator of PBPM costs include

- only Medicare program Part A and B payments; patient obligations and Part C (managed care) and D (drugs) are excluded;
- only claims for utilization of beneficiaries when they are eligible for the demonstration; and
- only claims for eligible services; end-stage renal disease [ESRD] and hospice services are excluded.

To statistically test hypotheses regarding *trends* in beneficiary costs, average PBPM costs first must be calculated at the beneficiary level. Constructing individual PBPM costs required dividing a beneficiary's total cost during eligible periods by his or her own eligible months during the base year or demonstration period. Most beneficiaries had 12 months of base year eligibility and 25 or 19 months of demonstration period eligibility. However, some beneficiaries had fewer than the maximum number of eligible months (or days), usually due to death. At the extreme, a beneficiary could have a 10-day hospital admission at the beginning of the intervention period with a combined Part A and B payment of $30,000 before dying. This $30,000 outlay would be divided by approximately 1/3 (10 days / 30.42 days), resulting in an adjusted PBPM outlay of $90,000. Consequently, (unweighted) PBPM costs exhibit substantial variation that, in turn, reduces the likelihood of finding statistical differences. To avoid excessive PBPM costs, intervention and comparison beneficiaries with less than three full months of eligibility during the demonstration period were excluded from the cost analyses.

Variation in costs also can be reduced by trimming high PBPM cost outliers at the 99th percentile, as done by CMS for financial reconciliation. While a 1% trim reduces the Phase II Health Buddy® Program at Montefiore Demonstration's financial risk, RTI wanted to avoid biasing cost savings against the intervention if it constrained spending among the most expensive beneficiaries.[6] Instead of trimming or deleting outliers, RTI weighted PBPM mean costs and standard errors by each beneficiary's eligible fraction of days, or exposure to the intervention. For example, PBPM costs based on just 5 of 25 months would be weighted by 0.20 in calculating mean costs across all intervention and comparison groups.

6.2.3 Monthly Fees

Demonstration Care Management Organizations (CMOs) proposed monthly fees when submitting their demonstration applications to the CMS Office of Demonstrations. At the beginning of Phase II, CMS negotiated final fees as part of each CMO's agreed-upon contract terms and conditions. The Phase II Health Buddy® Program at Montefiore Demonstration negotiated a constant monthly disease management fee of $132 for all three cohorts. No monthly fees were paid in the last three months of the demonstration. See ***Section 6.3.3*** for adjustments to monthly fees when determining budget neutrality.

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[6] Trimming was done by ARC for both intervention and comparison groups. This sometimes made the intervention savings higher but also sometimes lower.

6.3 Analytic Methods

RTI's analytic approach is based on a *comparison of growth rates in PBPM costs at the individual beneficiary level*. This approach has two principal strengths:

- First, it controls in a more precise, beneficiary-specific manner for any differences in PBPM costs between the base year and the demonstration period that are not accounted for through the intervention-comparison assignment process.

- Second, by calculating changes in PBPM costs at the beneficiary level (i.e., "paired" base-demonstration period PBPM costs), we can conduct statistical *t*-tests of the differences in spending growth rates between intervention and comparison groups.

In addition to answering the question of whether any or all of the CMHCB demonstration programs achieved budget neutrality (or even any savings), CMS also is interested in *generalizing* results to future care management activities by answering the question, "What savings are likely to be realized if the demonstration is expanded?" This question necessarily requires testing the hypothesis that any savings in a sample of beneficiaries during a particular time period could have been caused by chance with no long-run implications.

6.3.1 Tests of Gross Savings

Gross savings to Medicare are defined as the difference between the mean claims costs of the intervention and comparison groups. There are two ways to calculate these differences. Assuming that the selection process balanced the intervention and comparison populations, PBPM cost differences between the two groups can be based solely on the demonstration period, and the Phase II Health Buddy® Program at Montefiore Demonstration was neither advantaged nor disadvantaged by the costliness of their sample relative to their comparison group. However, some imbalances between the intervention and comparison groups may have remained prior to the go-live date. Also, because we wanted to conduct statistical tests of intervention effects, it was necessary to construct PBPM cost estimates at the beneficiary level and then use variation in the observations across beneficiaries to produce confidence intervals around the estimates. Recognizing that base year costs may be different between intervention and comparison populations, we used a mixed paired sample approach. First, we compared each beneficiary's own mean PBPM cost in the base year just prior to the Phase II program's start date with his or her costs in the intervention period. This was done separately for all beneficiaries in both the intervention and comparison groups. Next, we determined the mean difference in the differences in PBPM costs for each group, treating the mean differences as independent samples.[7] The strength of first calculating the change in PBPM costs at the beneficiary level is that it controls for the cost effects of any clinical and socioeconomic "cost-influencing" characteristics that might differ between the intervention and comparison groups. Any imbalances in beneficiary characteristics that might produce inter-temporal differences in medical utilization or costs are factored out using first-differencing. Our gross savings rate, in equation form, is

[7] For a more detailed description of this approach, see Rosner (2006, chapter 8).

$$\text{Gross Savings} = \text{Diff}[I] - \text{Diff}[C] = [I_t^* - I_b^*] - [C_t^* - C_b^*] = \Delta I^* - \Delta C^* \quad (6.1a)$$

or, equivalently, using ARC's approach:

$$\text{Gross Savings} = [I_t^* - C_t^*] - [I_b^* - C_b^*], \quad (6.1b)$$

where * = the mean value within intervention (I) or comparison (C) group, t and b = demonstration and base periods, and Δ = the change in mean PBPM costs between the base and demonstration periods. Savings, as the difference-in-(paired) differences (6.1a), is equivalent to adjusting the unweighted difference in intervention and comparison means during the demonstration by the mean difference that existed in the base year (eq. 6.1b). However, in calculating mean changes in PBPM costs across beneficiaries, each beneficiary's *change* needs to be weighted to produce an unbiased estimate of the overall mean change. We used the beneficiary's fraction of eligible days during the demonstration period as weights. This effectively weights each beneficiary's base, as well as demonstration, period PBPM costs by the beneficiary's proportion of days during the demonstration period. ARC's actuarial approach adjusted for baseline cost differences using equation (6.1b) without weighting. Beneficiaries with 12 baseline months received a self-weighted value of 1.0 in estimating mean baseline costs, C_b^*, even if they were only in the demonstration period for a few days or weeks. RTI's weighted approach, based on equation (6.1a), might give the change in costs a much lower weight. It did not seem reasonable to give beneficiaries with limited exposure in the actual demonstration full credit in calculating mean base year costs even if they had 12 months of base year Medicare eligibility. In addition to "downweighting" partial period eligibles, beneficiaries with less than 3 months demonstration eligibility also were dropped from both the intervention and comparison groups because it is unlikely that intervention beneficiaries would have shown immediate savings from the intervention.

6.3.2 Detectable Savings

In all of the analyses in this chapter, we test the hypothesis of whether gross savings before netting out fees are statistically different from zero. Gross savings must be sufficiently greater than zero to assure the government that the measured savings rate was not due to chance.[8] A critical evaluation question is the power we had to detect relatively small savings rates. By "detectable" we mean the rate of savings that would convince us to reject the null hypothesis of no reliable savings at all. Having completed the demonstration, we now have the information on both the mean costs and standard errors in savings rates that allows us to calculate the detectable savings threshold for the Phase II Health Buddy® Program at Montefiore Demonstration.

The fundamental test statistic is the Z-ratio of gross savings (see eq. 6.1a) relative to the standard error (SE) of the difference in growth rates:

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[8] Chance savings can occur because of (a) random fluctuations in the utilization of health services required in the intervention and comparison groups, or (b) the particular sample of beneficiaries involved in the study. It is possible that random declines (increases) in health in the intervention group unrelated to the intervention could explain lower (higher) savings rates.

$$Z = [\Delta I - \Delta C]/SE_{[\Delta I - \Delta C]} \quad (6.2)$$

$$SE_{[\Delta I - \Delta C]} = [SE_{\Delta I}{}^2 + SE_{\Delta C}{}^2]^{0.5}. \quad (6.3)$$

A two-sided test[9] of intervention savings at a 5% level of significance was used with the following confidence interval:

$$-1.96\ SE_{[\Delta I - \Delta C]} <= \text{Savings} <= 1.96\ SE_{[\Delta I - \Delta C]}, \quad (6.4)$$

This results in a negative detectable threshold, DT, of

$$\text{Detectable Threshold (DT)} = -1.96\ SE_{[\Delta I - \Delta C]}. \quad (6.5)$$

Intervention savings must be equal or less than -1.96 times the standard error of the difference in the growth rates in intervention and comparison PBPM costs. Savings are expressed in negative terms if intervention PBPM cost growth is less than the comparison group cost growth.

The detectable threshold is approximately double the standard error of the difference in mean growth rates, which in turn varies with the square root of the intervention and comparison group sample sizes.[10] It is also convenient for some analyses to express the DT as a percent of the comparison group's demonstration mean PBPM cost, or $DT/PBPM_c = -1.96[SE_{\Delta I - \Delta c}/PBPM_c]$.

Table 6-1, ***6-2, and 6-3*** show the variation in the (unweighted) PBPM costs in the base year and demonstration period for the Phase II Health Buddy® Program at Montefiore Demonstration's intervention and comparison groups for all three cohorts. The Phase I Original cohort's base year comparison PBPM costs ranged from $0 to $20,820 with a mean cost of $1,539. Base year intervention costs ranged between $0 and $42,835 with a mean of $1,617. Coefficients of variation were 136 and 160, indicating high cost variance on a PBPM cost basis. The distribution shows strong right skewness with median costs about one-third of mean costs. Cost distributions in Phase I Refresh and Phase II cohorts are similar to the distribution in the Phase I Original cohort. Unweighted demonstration period mean costs increased by 46% in the Phase I Original comparison and intervention groups, 29-36% in the Phase I Refresh cohort, and 7-10% in the Phase II cohort.

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[9] A reasonable argument can be made that the detectable threshold should be based on a one-sided *t*-test if one assumes that any chronic care management intervention would not be expected to *increase* Medicare outlays. If an intervention is likely only to reduce costs, a one-sided test effectively puts all 5% of the possible error on the negative side, resulting in a detectable threshold only -1.68 times the standard error. Also, policy makers are interested only in a one-sided test when faced with the decision to expand the program or not; that is, did the intervention save money while quality was maintained or improved.

[10] In all statistical tests in this chapter, the fact that demonstration and comparison beneficiaries are clustered within practices is ignored. Adjusting for clustering will raise the standard errors and reduce the likelihood of finding significant gross savings.

Table 6-1
Phase II Health Buddy® Program at Montefiore CMHCB Demonstration PBPM cost thresholds in base and demonstration periods for intervention and comparison groups: Phase I Original cohort

Quantiles[1]	Base year Comparison	Base year Intervention	Demonstration Period Comparison	Demonstration Period Intervention
(N)	(1,013)	(1,691)	(1,013)	(1,691)
Minimum	$0	$0	$0	$0
<10%	135	117	179	185
<25%	256	265	395	438
Median	580	634	1,052	1,070
>75%	1,715	1,814	2,741	2,898
>90%	4,430	4,143	5,743	5,768
Maximum	20,820	42,835	45,683	63,620
Mean	1,539	1,617	2,243	2,354
CV	135.69	159.64	129.75	146.49

NOTES: Observations unweighted; PBPM = per beneficiary per month; (N) = number of beneficiaries; CV = coefficient of variation.

[1] <10%, <25%, >75%, >90%: PBPMs below or above percentage.

SOURCE: Medicare 2009-2011 Part A & B claims; COSTRUN2 (12/5/12).

Table 6-2
Phase II Health Buddy® Program at Montefiore CMHCB Demonstration PBPM cost thresholds in base and demonstration periods for intervention and comparison groups: Phase I Refresh cohort

Quantiles[1]	Base year Comparison	Base year Intervention	Demonstration Period Comparison	Demonstration Period Intervention
(N)	(597)	(650)	(597)	(650)
Minimum	$0	$0	$0	$0
<10%	113	115	207	184
<25%	297	266	499	394
Median	638	576	1,086	1,074
>75%	1,777	1,621	3,015	2,511
>90%	4,565	4,333	5,086	5,117
Maximum	62,943	35,320	54,550	40,394
Mean	1,722	1,540	2,216	2,107
CV	174.31	170.32	130.60	137.44

NOTES: Observations unweighted; PBPM = per beneficiary per month; (N) = number of beneficiaries; CV = coefficient of variation.

[1] <10%, <25%, >75%, >90%: PBPMs below or above percentage.

SOURCE: Medicare 2009-2011 Part A & B claims; COSTRUN2 (12/5/12).

Table 6-3
Phase II Health Buddy® Program at Montefiore CMHCB Demonstration PBPM cost thresholds in base and demonstration periods for intervention and comparison groups: Phase II cohort

Quantiles[1]	Base year Comparison	Base year Intervention	Demonstration Period Comparison	Demonstration Period Intervention
(N)	(4,188)	(4,127)	(4,188)	(4,127)
Minimum	$0	$0	$0	$0
<10%	176	159	178	162
<25%	335	327	363	340
Median	824	815	887	844
>75%	2,248	2,304	2,438	2,399
>90%	5,026	5,069	5,286	5,645
Maximum	59,846	38,340	72,898	79,255
Mean	1,989	1,918	2,120	2,117
CV	158.11	144.12	157.77	159.28

NOTES: Observations unweighted; PBPM = per beneficiary per month; (N) = number of beneficiaries; CV = coefficient of variation.

[1] <10%, <25%, >75%, >90%: PBPMs below or above percentage.

SOURCE: Medicare 2009-2011 Part A & B claims; COSTRUN2 (12/5/12).

6.3.3 Budget Neutrality

Each CMO in the demonstration was obligated to produce net savings for the Medicare program. Budget neutrality, under contractual agreement, is dependent on the size of adjusted gross savings (GS) per beneficiary for the j-th cohort, GS_j^*, in the demonstration period:

$$GS_j^* = \alpha_j PBPM_c - PBPM_I \quad (6.6)$$

where α_j = the base period ratio of intervention to comparison group PBPM costs. If costs ($PBPM_c$) were higher in the intervention group's base period relative to the comparison group, then CMS adjusted comparison costs upwards in the demonstration period to account for the discrepancy. As long as adjusted comparison costs exceed intervention mean costs, gross savings are positive. Three scenarios capture the three possible financial settlements at the end of the demonstration:

Full Payback: $GS_j^* <= \theta_j PBPM_c$ (6.7)

Partial Fee Payback: $\theta_j PBPM_c < GS_j^* < MF_j + \theta_j PBPM_c$ (6.8)

Retain all Fees: $GS_j^* => \theta_j PBPM_c + MF_j$. (6.9)

When adjusted gross savings are less than the minimum required percentage of comparison group costs, the CMO must return all fees paid out. The required percentages, θ_j , for the Health Buddy® Program at Montefiore during the Phase II demonstration period were 5% for the Phase I Original cohort and 2.5% for the other two cohorts. If gross savings exceed minimum required savings but fall short of minimum savings plus the monthly fee (MF_j), then the participant must pay back the shortfall. Finally, the participant can retain all fees if gross savings equal or exceed required savings plus fees.

When ARC, the financial reconciliator, determines final budget neutrality and payback obligations, if any, it weights its estimate of gross savings per beneficiary by the number of intervention total eligible months. It then subtracts all accrued fees to produce a final savings figure. This approach effectively weights the nominal monthly fee (i.e., $132) by the ratio of fee-bearing to intervention total eligible months. Consequently, total fees will be lower with lower intervention participation rates and net savings will be greater for a given estimate of gross savings.

As the demonstration evaluator, RTI's conclusion regarding gross savings will differ from those of CMS and ARC during financial reconciliation, as previously described. In addition, RTI uses the Z-test against zero savings to test whether the intervention achieved any reliable, replicable, gross savings. A standard difference-in-differences design based on mean PBPM costs is used. RTI also tested for differences in PBPM cost growth rates between intervention beneficiary participants and nonparticipants relative to the comparison group. If the intervention had more success with those beneficiaries it actually engaged, then savings should be greater for participants than nonparticipants. Next, RTI estimated gross savings, regardless of significance, were debited by the adjusted monthly fee to produce an estimate of *net savings* per beneficiary. The adjusted monthly fee is the nominal fee times the ratio of fee-bearing to total intervention months. Finally, a CMS return on investment in fees was determined.

A drawback of the difference-in-differences method is that it does not control for baseline differences in beneficiary characteristics except for costs. It also does not provide a robust estimate of the savings that may have accrued to intervention beneficiaries using the Health Buddy® device.

6.3.4 Adjusting for Unbalanced Groups & Testing for Health Buddy® Device Savings

Because the Phase II Health Buddy® Program at Montefiore Demonstration's comparison group was not based on random sampling, it is possible that material imbalances remained between study and comparison groups simply by chance. If the distribution of beneficiaries differs between the Phase II Health Buddy® Program at Montefiore Demonstration's intervention

group and its comparison group, then demonstration period PBPM cost comparisons could be biased against the intervention. The same is true when comparing Health Buddy® device users with the comparison group. For differences in other beneficiary characteristics to have any effect on intervention savings, two situations must occur. First, one or more characteristics must have a statistically important effect on PBPM cost growth rates, not just on cost levels. Second, unless the same important characteristics also significantly differ in terms of frequency counts between the intervention and comparison groups, they will not affect the intervention savings rates in a material way. Because most characteristics are simple binary (0, 1) indicators, there must be substantial percentage point differences in the number of "costly" beneficiaries involved between the intervention and comparison groups.

Two approaches were used to test the effects of imbalances in base year characteristics between the intervention and comparison groups. First, we produced frequency distributions of key beneficiary characteristics between the two groups. If intervention and comparison frequencies are similar, then no (measurable) sample or cost bias should exist.

Table 6-4 compares the mix of beneficiary characteristics in the intervention, comparison, and Health Buddy® device groups for the Phase I Original cohort. Health Buddy® device users are beneficiaries agreeing to accept the Health Buddy® device in their home and complete one or more daily surveys. Intervention beneficiaries, compared with comparison beneficiaries, were less likely to be minority, eligible for Medicaid, or disabled. They appear to be somewhat healthier in the base period based on their lower HCC scores (p=n.s.).

Device users, compared with the comparison group, are more likely to be under age 65, or disabled, and more likely to be between the ages of 65 and 69. Device users are more commonly male and less likely to be over age 85 or eligible for Medicaid. The Health Buddy® device users' HCC scores are equal to those in the comparison group (p=n.s.). How any of these larger differences affect cost savings from the intervention will depend upon how each characteristic difference affects the *change* in costs.

Table 6-5 compares the mix of beneficiary characteristics in the intervention, comparison, and device groups for the Phase I Refresh cohort. Intervention beneficiaries, compared with comparison beneficiaries, were less likely to be minority or eligible for Medicaid. They were more likely to have been in a SNF during the base year. They appear to be somewhat healthier in the base period based on their lower HCC scores (p=n.s.).

Table 6-4
Phase II Health Buddy® Program at Montefiore CMHCB Demonstration percentages and means of beneficiary characteristics of intervention and comparison groups in the base year: Phase I Original Cohort

Characteristic	Intervention (%)	Comparison (%)	Device (%)
Age Group			
<65	4.5	7.5	4.0
65-69	3.9	3.8	7.2
70-74	13.7	16.8	15.3
75-79	21.7	20.7	21.5
80-84	23.4	21.7	23.1
85+	32.8	29.5	29.0
Gender			
Female	61.5	67.1	58.5
Male	38.5	32.9	41.5
Race			
Minority	32.0	59.7	45.6
White	68.0	40.3	54.4
Medicaid Eligible			
No	67.1	41.7	68.6
Yes	32.9	58.3	31.5
Disabled			
No	95.0	91.6	95.0
Yes	5.0	8.4	5.0
Long-term care			
No	99.9	100.0	100.0
Yes	0.1	0.0	0.0
Skilled Nursing Facility			
No	91.2	94.0	93.0
Yes	8.8	6.1	7.0
HCC Score Mean	1.40	1.51	1.51
Charlson Score Mean	2.80	2.85	2.97

NOTE: Beneficiaries weighted by fraction of eligible days in demonstration period.
HCC = Hierarchical Condition Category.

SOURCE: Medicare 2009-2011 Part A & B claims; Cost4b1mod (12/11/12).

Table 6-5
Phase II Health Buddy® Program at Montefiore CMHCB Demonstration percentages and means of beneficiary characteristics of intervention and comparison groups in the base year: Phase I Refresh Cohort

	Intervention (%)	Comparison (%)	Device (%)
Age Group			
<65	7.8	7.2	12.2
65-69	9.3	8.8	9.9
70-74	16.5	17.4	17.6
75-79	21.0	16.9	22.9
80-84	23.3	23.6	21.0
85+	22.1	26.2	16.4
Gender			
Female	65.3	68.2	72.3
Male	34.7	31.8	27.7
Race			
Minority	40.1	57.2	61.1
White	59.9	42.8	38.9
Medicaid Eligible			
No	63.1	37.5	57.5
Yes	36.9	62.5	42.5
Disabled			
No	92.0	91.5	87.8
Yes	8.0	8.5	12.2
Long-term care			
No	100.0	100.0	100.0
Yes	0.0	0.0	0.0
Skilled Nursing Facility			
No	93.1	94.6	93.3
Yes	6.9	5.4	6.7
HCC Score Mean	1.28	1.54	1.39
Charlson Score Mean	2.60	2.86	2.52

NOTE: Beneficiaries weighted by fraction of eligible days in demonstration period.
HCC = Hierarchical Condition Category.

SOURCE: Medicare 2009-2011 Part A & B claims; Cost4b1mod (12/11/12).

Health Buddy® device users, compared with the comparison group, are more likely to be under-age 65 disabled and less likely to be age 85 and older. Health Buddy® device users are less likely to be eligible for Medicaid. Their HCC and Charlson scores are somewhat lower than in the comparison group (p=n.s.). How any of these larger differences affect cost savings from the intervention will depend upon how each characteristic difference affects the *change* in costs.

Table 6-6 compares the mix of beneficiary characteristics in the intervention and comparison and the Health Buddy® device groups for the Phase II cohort. Intervention beneficiaries, compared with comparison beneficiaries, were generally quite similar except for being less likely to be eligible for Medicaid.

Health Buddy® device users, compared with the comparison group, are more likely to be under-age 65, disabled, and minority. Device users are less likely to be eligible for Medicaid. Their HCC scores are fairly similar to those in the comparison group (p=n.s.), but device users exhibited statistically higher Charlson scores (p<.01). How any of these larger differences affect cost savings from the intervention will depend upon how each characteristic difference affects the *change* in costs.

Because there were some sizable differences in patient characteristics between device users and the comparison group, we decided to apply propensity score weighting to the comparison group. This approach has been described in a previous chapter on the likelihood of participating in the intervention. These weights were combined with eligibility fraction weights when conducting analyses of cost savings.

RTI's second approach to imbalances used multivariate regressions to adjust for the effects of any imbalances on trends in PBPM costs. We pooled base and demonstration period observations across all three cohorts and regressed each beneficiary's own demonstration period PBPM cost on group status (I = intervention; C = comparison); each beneficiary's own base period ($PBPM_{pb}$) cost; an indicator for the beneficiary's cohort (Cht = Phase I Original, Phase I Refresh, and Phase II); and a vector of k base period beneficiary characteristics and two severity scores, HCC and Charlson (PChar):

$$PBPM_{pt} = \alpha + \gamma PBPM_{pb} + \beta Status + \Sigma_j \rho_j Cht_j + \Sigma_k \lambda PChar_{pk} + \varepsilon_{pt} \quad . \qquad (6.10)$$

The intercept, α, is the Phase I Original comparison group's average PBPM cost in the base year, while γ = the average fractional contribution to demonstration period costs of a $1 higher base period cost. γ provides a test of regression-to-the-mean (RtoM) effects. The smaller the γ, the greater the RtoM effects. The *t*-value for β tests the differences in cost increases between the intervention and comparison groups while ρ_j tests for differences in the growth rates for the three j cohort groups. By including each beneficiary's age, gender, race, urban/rural residence, disabled status, Medicaid eligibility, comorbid conditions, and institutionalized status at the start of the demonstration, we purge Status and other coefficients of any baseline differences between the intervention and comparison groups. Inclusion of these variables also narrows the confidence intervals around the other coefficients, thereby reducing detectable thresholds and giving more precise estimates of mean intervention effects (Greene, 2000, chapter 6).

Table 6-6
Phase II Health Buddy® Program at Montefiore CMHCB Demonstration percentages and means of beneficiary characteristics of intervention and comparison groups in the base year: Phase II Cohort

	Intervention (%)	Comparison (%)	Device (%)
Age Group			
<65	9.8	9.9	15.5
65-69	14.0	12.2	16.0
70-74	17.3	17.9	18.9
75-79	19.2	20.2	18.9
80-84	18.8	18.7	15.8
85+	20.8	21.1	15.0
Gender			
Female	65.4	65.5	64.5
Male	34.6	34.5	35.5
Race			
Minority	45.0	50.9	60.3
White	55.0	49.1	39.7
Medicaid Eligible			
No	59.8	43.9	56.1
Yes	40.2	56.1	43.9
Disabled			
No	89.2	89.2	83.7
Yes	10.8	10.8	16.3
Long-term care			
No	99.9	99.8	100.0
Yes	0.1	0.2	0.0
Skilled Nursing Facility			
No	92.7	95.3	93.1
Yes	7.3	4.7	6.9
HCC Score Mean	2.13	2.16	2.24
Charlson Score Mean	3.05	3.07	3.33

NOTE: Beneficiaries weighted by fraction of eligible days in demonstration period.
HCC = Hierarchical Condition Category.

SOURCE: Medicare 2009-2011 Part A & B claims; Cost4b1mod (12/11/12).

Equation (6.10) is also used to test for cost savings when using the Health Buddy® device. For this test, the Status variable is limited to 0 = comparison group and 1 = device user. In conducting this test, the comparison group was re-weighted using propensity scoring to match the mix of characteristics of device users. Including PChar in the model further controls for any initial imbalances.

6.4 PBPM Cost Levels and Trends

6.4.1 Phase I Original Cohort

Table 6-7 displays PBPM cost levels and rates of growth in average PBPM costs between the base year and the 25-month demonstration period for the Phase I Original cohort. Results are shown for the entire intervention group and for participating and nonparticipating beneficiaries, separately. Participants are beneficiaries in the intervention group who agreed to accept care management services. Health Buddy® device users are a subset of participants. PBPM costs in both periods have been weighted by the fraction of days beneficiaries were eligible in the demonstration period so as not to overweight beneficiaries who were exposed to the intervention for shorter periods. Propensity scoring was used to reweight the comparison group to match the intervention group. Only beneficiaries with at least 3 months of demonstration eligibility in both periods were included.

Table 6-7
Phase II Health Buddy® Program at Montefiore CMHCB Demonstration PBPM cost growth levels and rates between base year and demonstration period, intervention and comparison groups: Phase I Original cohort

Study group	Beneficiaries	Base year PBPM Mean[1]	Base year PBPM SE	Demo PBPM Mean[1]	Demo PBPM SE	Differences in means	SE
Intervention	1,691	$1,617	67.1	$2,354	89.6	$737**	87.4
Participants[2]	812	1,916	110.3	2,718	145.1	802**	134.9
Nonparticipants	879	1,322	77.1	1,994	106.1	672**	112.4
Comparison	1,013	1,575	70.4	2,285	103.7	710**	106.3
Differences							
I – C	—	42	102.7	69	141.2	27	140.0
Participants - C	—	342	126.4	434	174.1	92	169.3
Nonparticipants - C	—	-253**	104.3	-290*	149.0	-37	155.0
Participants - Nonparticipants	—	594**	133.5	724**	137.8	130	174.9

NOTE: PBPM = per beneficiary per month; I = intervention; C = comparison.

[1] Means weighted by beneficiary fraction of eligible days in demonstration period times propensity score "matching" weights.

[2] Includes subset of beneficiaries using Health Buddy® device.

Statistical tests for differences: *$p < .05$; **$p < .01$.

SOURCE: Medicare 2009-2011Part A&B claims; run costrun1a (12/5/2012).

Overall. The eligibility-weighted base year average PBPM cost was $42 more (2.7%) ($p$ = insig) in the intervention versus the comparison group ($1,617 versus $1,575). The intervention-comparison difference in PBPM Medicare costs increased slightly to $69 ($p$ = insig) in the demonstration period ($2,354 versus $2,285). Intervention beneficiaries remained 3% more costly, on average, than the comparison group. Between the base year and the end of the 25-month demonstration period, average comparison group PBPM costs increased significantly by $710 (p<.01) while the intervention group's PBPM average Medicare costs rose by $737 (p<.01). Consequently, the intervention group's PBPM cost rose $27 faster ($p$ = insig) than the comparison group's PBPM cost.

Participation Status. The participation rate, based on beneficiaries used in this cost analysis, was 48% (812/1,691). Participant costs in the Phase II Health Buddy® Program at Montefiore Demonstration intervention group were 22% higher ($342; p<.01) than in the comparison group in the base period. Non-participants were $253 less costly (p<.01). Participant costs rose by $92 (p=n.s.) relative to comparison costs over the demonstration period while non-participant costs grew $37 slower relative to the comparison group. Thus, the $27 faster growth in intervention PBPM costs over the demonstration period appears to be due entirely to faster growth in the participant group.

6.4.2 Phase I Refresh Cohort

Overall. ***Table 6-8*** displays PBPM cost levels and rates of growth in average PBPM costs between the base year and the end of the 25-month demonstration period for the Phase I Refresh cohort. The weighted base year average PBPM cost was $267 less ($p$ = insig) in the intervention versus comparison group ($1,540 versus $1,807). The intervention-comparison gap in PBPM costs shrank (-$159; p=n.s.) in the demonstration period ($2,107 versus $2,266). The average comparison group PBPM cost increased $459 (p<.01) while the intervention group's PBPM cost increased $567 (p<.01). As a result, the intervention group's PBPM cost increased $109 faster($p$ = insig) relative to the comparison group's. Intervention beneficiaries, who were 15% less costly at baseline, were 7% less costly than the comparison group, on average, in the demonstration period.

Participation Status. The participation rate for the Phase I Refresh cohort was 49% (321/650). Participants in the Phase II Health Buddy® Program at Montefiore Demonstration intervention group at baseline were $30 more costly (p=n.s.) than comparison group beneficiaries and non-participants were $572 less costly (p<.01). Participants became -$21 less costly (p=n.s.) during the demonstration period. Non-participants became -$406 less costly (p<.05) during the demonstration period. Consequently, the participant group's PBPM cost rose $53 faster (p=n.s.) than the comparison group's cost while the non-participant group's PBPM cost rose $166 faster (p=n.s.) than the comparison group's PBPM cost. Thus, the $109 in gross dis-savings in the Phase I Refresh cohort appears to be due to faster cost growth regardless for participation status.

Table 6-8
Phase II Health Buddy® Program at Montefiore CMHCB Demonstration PBPM cost levels and growth rates between base year and demonstration period, intervention and comparison groups: Phase I Refresh cohort

Study group	Beneficiaries	Base year PBPM Mean[1]	Base year SE	Demo PBPM Mean[1]	Demo PBPM SE	Differences in means	SE
Intervention	650	$1,540	109.9	$2,107	121.4	$567**	139.2
Participants[2]	321	1,836	175.0	2,348	157.0	512**	206.9
Nonparticipants	329	1,235	131.2	1,860	184.4	625**	186.5
Comparison	597	1,807	141.4	2,266	131.3	459**	166.0
Differences							
I – C	—	-267	177.5	-159	178.5	109	215.4
Participants – C	—	30	230.8	-21	158.2	53	271.5
Nonparticipants – C	—	-572**	215.3	-406*	224.6	166	264.5
Participants – Nonparticipants	—	602**	218.7	489*	242.2	-113	278.5

NOTE: PBPM = per beneficiary per month; I = intervention; C = comparison.

[1] Means weighted by beneficiary fraction of eligible days in demonstration period times propensity score "matching" weights.

[2] Includes subset of beneficiaries using Health Buddy® device.

Statistical tests for differences: *$p < .05$; **$p < .01$.

SOURCE: Medicare 2009-2011Part A&B claims; run costrun1a (12/5/2012).

6.4.3 Phase II Cohort

Overall. ***Table 6-9*** displays levels and rates of growth in average PBPM costs between the base year and the end of the demonstration period for the Phase II cohort. The weighted base year average PBPM cost was practically identical in the intervention and comparison group ($1,917 and $1,923). Comparison group PBPM costs increased $173 (p<.01) while intervention group costs increased $199 (p<.01). As a result, the intervention group's PBPM cost increased $27 faster (*p* = insig) than in the comparison group.

Participation Status. The participation rate for the Phase II cohort was 35% (1,425/4127). Participants in the base period in the Phase II Health Buddy® Program at Montefiore Demonstration intervention group were $281 more costly (p<.01) than comparison group beneficiaries and non-participants were $162 less costly (p<.05). The participant group's PBPM cost rose $50 slower (p=n.s.) than the comparison group's cost while the non-participant group's PBPM cost rose $69 faster (p=n.s.) than the comparison group's PBPM cost. Thus, the $27 in gross dis-savings in the Phase II cohort appears to be due to faster cost growth among non-participants.

Table 6-9
Phase II Health Buddy® Program at Montefiore CMHCB Demonstration PBPM cost levels and growth rates between base year and demonstration period, intervention and comparison groups: Phase II cohort

Study group	Beneficiaries	Base year PBPM Mean[1]	Base year SE	Demo PBPM Mean[1]	Demo PBPM SE	Differences in means	SE
Intervention	4127	$1,917	44.7	$2,117	54.5	$199**	59.3
Participants[2]	1425	2203	80.6	2,326	87.9	123	100.2
Nonparticipants	2702	1,761	53.1	2002	69.2	241**	73.5
Comparison	4188	1,923	48.0	2,095	52.9	173**	62.6
Differences							
I – C	—	-5	65.6	21	76.0	27	86.3
Participants – C	—	281**	94.2	231*	103.6	-50	121.5
Nonparticipants – C	—	-162*	73.6	-93	86.3	69	98.0
Participants - Nonparticipants	—	443**	93.2	324**	113.9	-119	123.9

NOTE: PBPM = per beneficiary per month; I = intervention; C = comparison.

[1] Means weighted by beneficiary fraction of eligible days in demonstration period times propensity score "matching" weights.

[2] Includes subset of beneficiaries using Health Buddy® device.

Statistical tests for differences: *$p < .05$; **$p < .01$.

SOURCE: Medicare 2009-2011Part A&B claims; run costrun1a (12/5/2012).

6.5 Savings and Budget Neutrality

6.5.1 Phase I Original Cohort

Table 6-10 presents summary statistics on savings from the Phase II Health Buddy® Program at Montefiore Demonstration Phase I Original intervention cohort. It also includes the minimum level of savings necessary to achieve statistical significance, expressed in negative terms as a percentage of the comparison group's PBPM cost. The Phase II Health Buddy® Program at Montefiore Demonstration's monthly fee is also reported as a percentage of the comparison group's PBPM cost.

Over the course of the 25-month intervention, average monthly costs increased $737 in the intervention group and $710 in the comparison group. The result was a $27 relative increase in PBPM cost growth in the intervention group. This positive difference implies gross dis-savings at a rate of 1.2% of the comparison group's demonstration period PBPM cost. These dis-savings were statistically insignificant.

Table 6-10
Phase II Health Buddy® Program at Montefiore CMHCB Demonstration average PBPM gross savings, fees, and budget neutrality status: Phase I Original cohort

Description	PBPM cost change
Intervention group	$737
Comparison group	710
Gross (dis)-savings PBPM	($27)
Gross (dis)saving %[1]	1.2%
Minimal Detectable Savings[2]	
Dollar amount	-$275
% of comparison PBPM cost[3]	-12.0%
Monthly Fee	
Average dollar amount	$132
Fee-bearing adjusted dollar amount[4]	$33
% of fee-bearing comparison PBPM cost[4]	1.4%
Net Fee (Adjusted)	
Dollar amount [5]	$60
% of comparison PBPM cost[3]	2.6%
Return on Investment (RoI)[6]	-0.82

NOTES: PBPM = per beneficiary per month.

[1] Gross (Dis)Savings % = Difference in PBPM cost changes as % of comparison demonstration PBPM ($2,285). Negative values imply savings. Savings based on cost differences weighted by eligibility fractions times propensity scores.

[2] Minimal Detectable Savings = 1.96*standard error of difference in mean PBPM cost changes.

[3] % Comparison PBPM cost = Dollar amount as % of comparison PBPM ($2,285) in demonstration period.

[4] Average monthly fee ($132) reduced by ratio of fee-bearing to intervention total eligible months.

[5] Dollar amount = Adjusted average monthly fee + gross savings.

[6] RoI = Gross savings /Adjusted average monthly fee (+1.0 = breakeven).

SOURCE: Medicare 2009-2011 Part A&B claims; PBPM cost changes and detectable savings taken from Table 6-7; monthly fees based on ARC Final Reconciliation for Health Buddy East Phase 2, June 14, 2012, Tables 3.

The minimally detectable savings threshold was -$275 using a two-sided 5% confidence level. This threshold level was 12% of the comparison group's PBPM cost. The intervention would have had to achieve this percentage for the rate of savings to be considered statistically reliable in repeated samples.[11] The Phase II Health Buddy® Program at Montefiore Demonstration's average monthly fee was $132 which amounted to 5.8% of the comparison group's PBPM cost. However, fees were paid only on 24.8% of intervention eligible months, thereby producing an adjusted fee of $33. Therefore, the Phase II Health Buddy® Program at Montefiore Demonstration would have had to achieve 6.4% (5% + 1.4%) savings in order to retain all fees according to RTI's calculations, which are not official under financial reconciliation[12].

If one accepted Phase II Health Buddy® Program at Montefiore Demonstration's intervention dis-savings of $27, then the net fee to Medicare would be $60 instead of $33. Medicare's rate of return on investment would be -0.82, implying a loss of $0.82 for every $1 invested in the intervention.

6.5.2 Phase I Refresh Cohort

Table 6-11 presents summary statistics on savings from the Phase II Health Buddy® Program at Montefiore's Demonstration Phase I Refresh cohort. Over the course of the 25-month intervention, average monthly costs increased $567 in the intervention group and $459 in the comparison group. The result was a $109 faster relative increase in PBPM costs in the intervention group. This positive difference implies gross dis-savings at a rate of 4.8% of the comparison group's PBPM cost.

With less than 700 beneficiaries in the intervention or comparison group, the minimally detectable savings threshold was -$422 at the 5% 2-sided confidence level. This rate is -18.6% of the comparison group's PBPM cost, implying that the intervention would have had to achieve this percentage of savings to be considered statistically reliable in repeated samples. With the addition of $109 in dis-savings, the net fee to Medicare was increased from $33 per beneficiary per month to $142, resulting in a net Medicare cost of 6.3% of the comparison group's average monthly PBPM cost. Medicare's return on investment was -3.3.

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[11] If minimal savings were based just on differences in PBPM costs during the demonstration period, the intervention would have to achieve a 12.1% savings rate (141.2(1.96)/$2,285) based on RTI's methodology. A one-sided 5% test would require 10% savings.

[12] ARC's unadjusted comparison PBPM = $2,312 which, when multiplied by the 37,048 intervention eligible months gives $85,646,455 in total comparison costs (see ARC Health Buddy East Phase 2 Final Reconciliation, June 14, 2012). ARC determined total required savings to be $5,522,252 (Table 1), thereby producing a ratio of 6.4%, a figure very similar to RTI's estimate.

Table 6-11
Phase II Health Buddy® Program at Montefiore CMHCB Demonstration average PBPM gross savings, fees, and budget neutrality status: Phase I Refresh cohort

Description	PBPM cost change
Intervention group	$567
Comparison group	$459
Gross (dis)-savings PBPM	($109)
Gross (dis)saving %[1]	4.8%
Minimal Detectable Savings[2]	
Dollar amount	-$422
% of comparison PBPM cost[3]	-18.6%
Monthly Fee	
Average dollar amount	$132
Fee-bearing adjusted dollar amount[4]	$33
% of fee-bearing comparison PBPM cost[4]	1.5%
Net Fee (Adjusted)	
Dollar amount [5]	$142
% of comparison PBPM cost[3]	6.3%
Return on Investment (RoI)[6]	-3.3

NOTES: PBPM = per beneficiary per month.

[1] Gross (Dis)Savings % = Difference in PBPM cost changes as % of comparison demonstration PBPM ($2,266). Negative values imply savings. Savings based on cost differences weighted by eligibility fractions times propensity scores.

[2] Minimal Detectable Savings = 1.96*standard error of difference in mean PBPM cost changes.

[3] % Comparison PBPM cost = Dollar amount as % of comparison PBPM ($2,266) in demonstration period.

[4] Average monthly fee ($132) reduced by ratio of fee-bearing to intervention total eligible months.

[5] Dollar amount = Adjusted average monthly fee + gross savings.

[6] RoI = Gross savings /Adjusted average monthly fee (+1.0 = breakeven).

SOURCE: Medicare 2009-2011 Part A&B claims; PBPM cost changes and detectable savings taken from Table 6-7; monthly fees based on ARC Final Reconciliation for Health Buddy East Phase 2, June 14, 2012, Tables 3.

6.5.3 Phase II Cohort

Table 6-12 presents summary statistics on savings from the Phase II Health Buddy® Program at Montefiore Demonstration intervention with the Phase II cohort. Over the course of the 19-month intervention, average monthly costs increased $199 in the intervention group and $173 in the comparison group. The result was a $27 faster relative increase in PBPM costs in the intervention group. This positive difference implies gross dis-savings at a rate of 1.3% of the comparison group's PBPM cost.

Table 6-12
Phase II Health Buddy® Program at Montefiore CMHCB Demonstration average PBPM gross savings, fees, and budget neutrality status: Phase II cohort

Description	PBPM cost change
Intervention group	$199
Comparison group	$173
Gross (dis)-savings PBPM	($27)
Gross (dis)saving %[1]	1.3%
Minimal Detectable Savings[2]	
Dollar amount	-$169
% of comparison PBPM cost[3]	-8.1%
Monthly Fee	
Average dollar amount	$132
Fee-bearing adjusted dollar amount[4]	$61
% of fee-bearing comparison PBPM cost[4]	2.9%
Net Fee (Adjusted)	
Dollar amount [5]	$88
% of comparison PBPM cost[3]	4.2%
Return on Investment (RoI)[6]	-0.44

NOTES: PBPM = per beneficiary per month.

[1] Gross (Dis)Savings % = Difference in PBPM cost changes as % of comparison demonstration PBPM ($2,095). Negative values imply savings. Savings based on cost differences weighted by eligibility fractions times propensity scores.

[2] Minimal Detectable Savings = 1.96*standard error of difference in mean PBPM cost changes.

[3] % Comparison PBPM cost = Dollar amount as % of comparison PBPM ($2,095) in demonstration period.

[4] Average monthly fee ($132) reduced by ratio of fee-bearing to intervention total eligible months. Fees paid on all participants plus intervention non-participants during first 6 months of intervention.

[5] Dollar amount = Adjusted average monthly fee + gross savings.

[6] RoI = Gross savings /Adjusted average monthly fee (+1.0 = breakeven).

SOURCE: Medicare 2009-2011 Part A&B claims; PBPM cost changes and detectable savings taken from Table 6-7; monthly fees based on ARC Final Reconciliation for Health Buddy East Phase 2, June 14, 2012, Tables 3.

With over 4,000 beneficiaries in the intervention or comparison group, the minimal detectable savings threshold was -$169 at the 5% 2-sided confidence level. This rate is -8.1% of the comparison group's PBPM cost, implying that the intervention would have had to achieve this percentage of savings to be considered statistically reliable in repeated samples. With the addition of $27 in dis-savings, the net fee to Medicare was increased from $61 per beneficiary per month to $88, resulting in a net Medicare cost of 4.2% of the comparison group's average monthly PBPM cost. Medicare's return on investment was -0.44.

6.6 Multivariate Regression Tests of Intervention & Health Buddy® Device Users Savings

Table 6-13 presents two sets of weighted least squares regression coefficient estimates, one set comparing the entire intervention with the entire comparison group, and a second set comparing only Health Buddy® device users with the entire comparison group. See ***Section 6.3.4*** for details. The intervention versus comparison regression uses weights based on the product of beneficiary demonstration period eligibility fractions and intervention-matched propensity scores. Beneficiaries with less than 3 months of eligibility are excluded from the regression modeling. The Health Buddy® device user versus comparison regression uses the same eligibility fractions but multiplied by Health Buddy® device-user propensity score weights for the comparison group. Both models are estimated based on a pooled model including all three Phase II cohorts. Besides propensity score weights, several beneficiary demographic, Medicare-Medicaid eligibility, base period long-term and SNF care, and HCC and Charlson severity measures are included in the model. The intercept reference group includes the Phase II, white, female comparison population, under age 65, non-Medicaid, with no long-term hospital or SNF use in the base year.

Table 6-13
Phase II Health Buddy® Program at Montefiore CMHCB Demonstration regression results, intervention or Health Buddy® device users versus comparison group, all Phase II cohorts

	Intervention vs. comparison		Health Buddy® device user vs. comparison	
Independent variable	PBPM_ Demo Coefficient	*p-value*	PBPM_ Demo Coefficient	*p-value*
Intercept	632	0.079	746	0.110
Intervention or Device user	31	0.601	15	0.848
Original Cohort	589	0.000	716	0.000
First Refresh Cohort	476	0.000	292	0.026
Baseline PBPM Cost	0.250	0.000	0.310	0.000
Male	96	0.130	42	0.618
Minority	44	0.488	5	0.949

(continued)

Table 6-13 (continued)
Phase II Health Buddy® Program at Montefiore CMHCB Demonstration regression results, intervention or Health Buddy® device users versus comparison group, all Phase II cohorts

	Intervention vs. comparison		Health Buddy® device user vs. comparison	
Independent variable	PBPM_ Demo Coefficient	*p-value*	PBPM_ Demo Coefficient	*p-value*
Age				
65-69	30	0.929	112	0.799
70-74	-67	0.850	-19	0.968
75-79	-6	0.986	-61	0.895
80-84	12	0.973	-1	0.999
85+	171	0.632	165	0.724
Medicaid	-1	0.337	-1	0.463
Disabled	0	0.901	2	0.700
Long-term Care	-5,232	0.000	-8,205	0.000
Skilled Nursing Facility	-343	0.013	-604	0.001
HCC Score	444	0.000	343	0.000
Charlson Score	17	0.243	-8	0.677
R^2	0.101		0.122	
N	12,266		7,196	

NOTES: Dependent Variable: Beneficiary's demonstration period PBPM cost. PBPM = per beneficiary per month; N = number of beneficiaries. Long-term care, skilled nursing facility = 1 if beneficiary had payments for either type of service in base year times propensity score weights. Comparison propensity scores matched to entire intervention group in col.2 and to device users only in col. 4. Intervention and comparison observations weighted by product of eligibility fraction and propensity score.

SOURCE: Medicare 2009-9011 Part A&B claims. Run Cost6 (12/17/12); Cost6 (12/17/12).

The dependent variable is each beneficiary's mean demonstration period PBPM cost regressed on each beneficiary's own base period mean cost. Regression estimates, consequently, are interpreted as the average change in costs per beneficiary between the intervention and baseline periods.

6.6.1 Intervention versus Comparison Results

The pooled model had 12,265 degrees of freedom, or approximately the same number of intervention and comparison beneficiaries in the three cohorts combined. The model explained 10% of the change in beneficiary costs. The base period PBPM cost estimate of 0.25 implies considerable regression-to-the-mean across beneficiaries. The Phase I Original and Refresh cohorts show significantly greater cost increases over base costs than does the Phase II cohort.

This is consistent with a lower time lapse between the time that base and demonstration period mean costs are calculated for the Phase II cohort.

Controlling for other variables in the model, and adjusting (through weighting) for any differences in eligibility lengths and sampling differences, the intervention change in mean costs was $31.15 greater than the corresponding comparison change in costs. This difference was not significant from zero at even the 10% confidence level.

Beneficiaries with long-term hospital or SNF use in the base period showed statistically lower cost increases during the intervention period even after adjusting for average regression-to-the-mean effects of higher base period costs. Higher HCC scores in the base period, by contrast, were a strong positive predictor of higher-than-average cost increases.

6.6.2 Health Buddy® device user versus Comparison Results

The pooled model had 7,195 degrees of freedom comprised of approximately 5,800 comparison beneficiaries and 1,400 Health Buddy® device users. The model explained 12% of the change in beneficiary costs. The base period PBPM cost estimate of 0.31 again implies considerable regression-to-the-mean across beneficiaries. The Phase I Original and Refresh cohorts again show significantly greater cost increases over base costs than does the Phase II cohort.

Controlling for other variables in the model, and adjusting (through weighting) for any differences in eligibility lengths and sampling differences, the Health Buddy® device user change in mean costs was $15.06 less than the corresponding comparison change in costs. This difference was not significant from zero at even the 10% confidence level.

Beneficiaries with long-term hospital or SNF use in the base period continued to show statistically lower cost increases during the intervention period even after adjusting for average regression-to-the-mean effects of higher base period costs. Higher HCC scores remain a strong positive predictor of higher-than-average cost increases.

6.7 Conclusion

PBPM costs showed considerable variability because of the nature of the population selected for the demonstration, including a few very high cost beneficiaries with short spells of eligibility. With only 1,691 Phase I Original and 650 Phase I Refresh beneficiaries in the intervention group, we had limited our power to detect significant savings. Gross savings had to be 12% in the Phase I Original population and nearly 19% in the Phase I Refresh cohort to be considered significant at the 5% 2-sided confidence level. The Phase II cohort, by contrast, had much larger samples: 4,127 intervention and 4,188 comparison beneficiaries. Even still, gross savings had to be in excess of 8% of comparison PBPM cost to be statistically significant.

Based on RTI's methods, gross savings from the Phase II Health Buddy® Program at Montefiore Demonstration intervention did not approach minimally required savings. Costs rose $27 faster in the Phase I Original intervention group, and Medicare's return on investment was slightly negative. An RoI = 1.0 is required for breakeven. Costs increased $109 faster in the Phase I Refresh intervention group, again resulting in a negative RoI. Intervention cohort costs

also increased $27 faster in the larger Phase II cohort. None of the increases were statistically significant from zero.

Intervention and comparison groups were somewhat unbalanced. Intervention beneficiaries were less likely to be minority or Medicaid-eligible. However, controlling for imbalances had no material effects on our overall final conclusion of no significant savings.

The Phase II Health Buddy® Program at Montefiore Demonstration's negotiated monthly case management fee was $132 which was about 6% of the comparison group's PBPM cost. But because of relatively low participation rates, gross savings of only 1.5-3.0% would have been necessary to achieve budget neutrality, ignoring the 5% and 2.5% minimum savings thresholds. However, savings rates at these percentages would have been highly insignificant. Moreover, they would have been statistically insignificant even when adding in the minimum savings thresholds because of the high variation in beneficiary average monthly costs and small sample sizes. This is true even after excluding beneficiaries with less than 3 months of exposure to the intervention.

A special multivariate analysis quantified cost savings based on a small (approximately 1,400) group of beneficiaries that used the Health Buddy® monitoring device. As with the overall intervention group, this subgroup did not demonstrate significant savings at any reasonable statistical threshold.

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CHAPTER 7
KEY FINDINGS FROM THE PHASE II HEALTH BUDDY® PROGRAM AT MONTEFIORE'S CARE MANAGEMENT FOR HIGH COST BENEFICIARIES DEMONSTRATION EVALUATION

The purpose of this report is to present the findings from RTI International's evaluation of the Phase II Health Buddy® Program at Montefiore, a Care Management for High Cost Beneficiaries (CMHCB) demonstration program jointly implemented by Robert Bosch Healthcare Systems, Inc. (RBHC) and Montefiore Medical Center's (MMC's) Care Management Organization. Our evaluation focuses upon three broad domains of inquiry:

- **Implementation.** To what extent was the Phase II Health Buddy® Program at Montefiore able to implement its program?
- **Reach.** How well did the Phase II Health Buddy® Program at Montefiore engage its intended audience?
- **Effectiveness.** To what degree was the Phase II Health Buddy® Program at Montefiore able to improve clinical quality and health outcomes and achieve targeted cost savings?

Organizing the evaluation into these areas focuses our work on the policy needs of the Centers for Medicare & Medicaid Services (CMS) as it considers the future of population-based care management programs or other interventions in Medicare structured as pay-for-performance initiatives. We used both qualitative and quantitative research methods to address a comprehensive set of research questions within these three broad domains of inquiry.

7.1 Key Findings

In this section, we present key findings based upon the 25 months of the Phase II Health Buddy® Program at Montefiore Demonstration operations with its Phase I original and refresh populations and 19 months with its Phase II population. Our findings are based on the experience of 12,266 ill Medicare fee-for-service (FFS) beneficiaries split across 6 groups for analysis purposes (Phase I original and refresh intervention and comparison groups and Phase II intervention and comparison groups) limiting statistical power somewhat to detect differences. This limitation is most notable for the Phase I refresh population with only 650 intervention and 597 comparison beneficiaries. Six key findings on participation, intensity of engagement in the HBC program, clinical quality, health outcomes, and financial outcomes have important policy implications for CMS and future care management efforts among Medicare FFS beneficiaries. The CMHCB demonstration program held the Phase II Health Buddy® Program at Montefiore Demonstration financially responsible for financial savings but not for quality of care improvements.

Key Finding #1: We observe a lower rate of mortality among intervention beneficiaries that used the Health Buddy® device.

We do not observe a statistically significant differential rate of mortality between the intervention and comparison groups for the three groups of Phase II beneficiaries. In stark contrast, when we examined mortality for intervention beneficiaries who used the Health Buddy® device relative to the full comparison group, we observed a statistically significant survival benefit among Health Buddy® device users in the multivariate survival model; a hazard ratio of 0.615. This finding is consistent with findings in our evaluation of both Phase I and Phase II of the Health Buddy® West program.

Key Finding #2: The Phase II Health Buddy® Program at Montefiore Demonstration was able to engage beneficiaries who were at higher risk of acute clinical deterioration or higher predicted costs during the demonstration period.

Within the Phase I original population, beneficiaries with high baseline PBPM costs and Charlson scores were more likely to participate, indicating that RBHC staff did attempt to engage the sicker Medicare beneficiaries. Similar results were found for the Phase I refresh population – beneficiaries with medium and high baseline HCC scores were more likely to participate – and the Phase II population – beneficiaries with high baseline PBPMs costs were more likely to participate. These results suggest that the Phase II Health Buddy® Program at Montefiore Demonstration was successful at engaging the sicker and more costly beneficiaries in their Phase II program.

Key Finding #3: Forty percent of the intervention population consented to participate in the Phase II Health Buddy® Program at Montefiore Demonstration and 22% of the intervention population agreed to use the Health Buddy® device.

Of the Phase II Health Buddy® Program at Montefiore Demonstration Phase I original intervention beneficiaries, 48% verbally consented to participate in the CMHCB demonstration at some point during the intervention period; 49% of the Phase I refresh population and 35% of the Phase II population agreed to participate. A cornerstone of the Phase II Health Buddy® Program at Montefiore was the Health Buddy® device and interactions with care managers to address gaps in knowledge or self-management of their chronic diseases. Of the 6,468 intervention beneficiaries, 1,399 beneficiaries (22%) agreed to participate in the program and used the device to complete at least one survey. Under an intent-to-treat model, participation by less than one-half of the intervention beneficiaries and active engagement by less than one-quarter of the intervention beneficiaries requires that the Phase II Health Buddy® Program at Montefiore has a large intervention effect on the beneficiaries with whom the staff members were actively engaging through the use of the Health Buddy® device to achieve the desired outcomes.

Key Finding #4: We find no evidence of systematic improvement in the rate of compliance in five quality-of-care process measures. Rates of compliance with 3-of-5 quality-of-care process measures were over 80% at baseline providing limited opportunity for improvement. The general trends during the demonstration were stable or modestly decreasing rates of compliance in both the intervention and comparison groups.

We have defined quality improvement for this evaluation as an increase in the rate of receipt of claims-derived, evidence-based quality-of-care measures although increasing rate of receipt of quality-of-care process measures was not a performance metric in the Phase II program. We selected four measures appropriate for Medicare beneficiaries with diabetes: annual low-density lipoprotein cholesterol (LDL-C) testing, HbA1c testing, eye examination, and nephropathy screening. We selected annual lipid panel for Medicare beneficiaries with ischemic vascular disease. Only one measure, HbA1c, exhibited a statistically significant difference in the rate of receipt of evidence-based care between the intervention and comparison groups, and only for the Phase II population. Beneficiaries in the Phase II population intervention group had a 1 percentage point increase in the receipt of HbA1c with a 2 percentage point decrease in the comparison group.

Key Finding #5: Rates of acute care utilization increased during the demonstration in both the intervention and comparison groups for all three populations with no statistically significant differences in the rate of growth. However, we do observe a trend toward lower rates of growth for two-thirds of the acute care utilization measures.

During the course of the HBC demonstration, we observed increasing rates of all-cause and ambulatory care sensitive condition (ACSC) hospitalizations, ER visits, and 90-day readmissions in both the intervention and comparison groups and for all three populations. Although we observed no statistically significant differential rates of growth in the acute care utilization measures, we observed a trend toward lower rates of growth within all three Phase II intervention populations for two-thirds of the acute care utilization measures with a number of the D-in-D rates appearing to be of clinical significance although not statistically significant.

Key Finding #6: Medicare cost growth was faster in the Phase I original, Phase I refresh, and Phase II intervention groups, but none of the trends were statistically significant.

PBPM costs showed considerable variability because of the nature of the population selected for the demonstration. With only 1,691 Phase I Original and 650 Phase I Refresh beneficiaries in the intervention group, we had limited our power to detect significant savings. Gross savings had to be 12% in the Phase I Original population and nearly 19% in the Phase I Refresh cohort to be considered significant at the 5% 2-sided confidence level. The Phase II cohort, by contrast, had much larger samples: 4,127 intervention and 4,188 comparison beneficiaries. Even still, gross savings had to be in excess of 8% of comparison PBPM cost to be statistically significant.

Based on RTI's methods, gross savings from the Phase II Health Buddy® Program at Montefiore Demonstration intervention did not approach minimally required savings. Costs rose $27 faster in the Phase I Original intervention group, and Medicare's return on investment was slightly negative. An RoI = 1.0 is required for breakeven. Costs increased $109 faster in the

Phase I Refresh intervention group, again resulting in a negative RoI. Intervention cohort costs also increased $27 faster in the larger Phase II cohort. None of the increases were statistically significant from zero. Further, a 6-month delay in receiving the Phase II population and early termination of the Phase II program put additional pressure on the program staff to achieve the necessary savings to generate a positive ROI in a shortened timeframe.

Intervention and comparison groups were somewhat unbalanced. Intervention beneficiaries were less likely to be minority or Medicaid-eligible. However, controlling for imbalances had no material effects on our overall final conclusion of no significant savings.

The Phase II Health Buddy® Program at Montefiore Demonstration's negotiated monthly case management fee was $132 which is about 6% of the comparison group's PBPM cost. But because of relatively low participation rates, gross savings of only 1.5-3.0% would have been necessary to achieve budget neutrality, ignoring the 5% and 2.5% minimum savings thresholds. However, savings rates at these percentages would have been highly insignificant. Moreover, they would have been statistically insignificant even when adding in the minimum savings thresholds because of the high variation in beneficiary average monthly costs and small sample sizes. This is true even after excluding beneficiaries with less than 3 months of exposure to the intervention.

A special multivariate analysis quantified cost savings based on a small (approximately 1,400) group of beneficiaries that used the Health Buddy® device. As with the overall intervention group, this subgroup did not demonstrate significant savings at any reasonable statistical threshold.

7.2 Conclusion

Based on extensive quantitative analysis of performance using statistical tests at standard 5% confidence levels, we did not detect improvement in key processes of care, acute care utilization, or costliness of care. However, we observed an incremental increase in survival benefit among the Phase II intervention beneficiaries who used the Health Buddy® device relative to the comparison group.

What might explain the lack of *overall* program effectiveness? One factor may be beneficiary recruitment challenges. Only 40% of intervention beneficiaries agreed to participate and 22% agreed to use the Health Buddy® device, a key component of the program. Given the Phase II Health Buddy® Program at Montefiore Demonstration's monthly management fee ($132 per month) and the population-based design of this demonstration, less than full engagement of the intervention population required the Phase II Health Buddy® Program at Montefiore Demonstration's to have been extremely successful with the actively engaged beneficiaries. MMC's CMO and RBHC staff identified a number of recruitment challenges that they felt adversely affected their ability to recruit. Approximately 1,000 beneficiaries had telephone numbers that were not correct or operational and were therefore considered unreachable. Thus, about 1,000 beneficiaries out of 6,000 Phase II beneficiaries were not reachable at all. Another challenge noted was the 6-month delay in receiving the program's Phase II population from CMS. This presented staffing challenges as well as shortened the length of time the program staff would be able to work with the Phase II population. Further, program staff felt that the new

"once out always out rule" eligibility criterion imposed during Phase II reduced their ability to keep beneficiaries actively participating. A number of beneficiaries lived in other locations during the winter and became ineligible for the program when they changed their mailing address for the winter. Approximately 5% of beneficiaries may have been affected by this decision.

A second factor may be the model of intervention itself. Prior evaluations of Medicare care management programs that were primarily telephonic have not demonstrated savings sufficient to cover fees similar to the Phase II Health Buddy® Program at Montefiore Demonstration's fee. A cornerstone of the Phase II Health Buddy® Program at Montefiore Demonstration's program was health coaching interactions with care manager nurses in response to alerts generated by the Health Buddy® device. Nearly all participating beneficiaries using the Health Buddy® device received at least one call from a care manager and many beneficiaries had a high degree of contact with their care managers compared to other care management programs that we have evaluated. However, the Health Buddy® care managers often were not in direct proximity to their beneficiaries' primary care physicians, thereby potentially affecting their interactions with the beneficiaries' primary providers, changing medical care plans, or mitigating deterioration in health status. The care manager served primarily as an adjunct to the patients' primary physicians. Additionally, if the patient had a relationship with a number of physicians or with a physician outside the Montefiore network it became more challenging to tie in the physician piece.

Yet, we do observe an incremental increase in survival benefit among intervention beneficiaries who used the Health Buddy® device. This finding is consistent with findings in our evaluation of both Phase I and Phase II of the Health Buddy® West program. The evaluation of the Phase II Health Buddy® at Montefiore program provided an additional test. And, in contrast to the analyses conducted in the prior evaluation, we have taken an additional step of developing propensity score weights to further align characteristics of the full comparison group to the users of the Health Buddy® device in an effort to reduce potential selection bias. We remain concerned that we may not have controlled for unobserved factors that are correlated with mortality as the percentage of intervention beneficiaries who agreed to use the Health Buddy® device is very low -- less than one-quarter of eligible intervention beneficiaries agreed to use the Health Buddy® device. A randomized trial of Medicare FFS beneficiaries, who had demonstrated a willingness to use the Health Buddy® device, would provide a powerful adjunct to these promising findings.

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SUPPLEMENT 2A
DETAILED SPECIFICATIONS FOR THE CONSTRUCTION OF CLINICAL ANALYTIC VARIABLES

1. Health Status Variables

1. Charlson Comorbidity Index SAS Code

Array all the diagnoses from the dataset and search for each of the codes in the Charlson categories. If any are found, the category has a value of 1, else 0. Add weighted categories to create Charlson score.

```
AMI=0;          Acute Myocardial Infarction;
CHF=0;          Congestive Heart Failure;
PVD=0;          Peripheral Vascular Disease;
CVD=0;          Cerebrovascular Disease;
dementia=0;     Dementia;
COPD=0;         Chronic Pulmonary disease;
conn_tissuedz=0; Connective Tissue disease;
ulcer=0;        Ulcer disease;
liverdz_mild=0; Mild liver disease;
diabetes=0;     Diabetes without complications;
hemiplegia=0;   Hemiplegia;
CRF=0;          Moderate or severe renal disease;
DMwcc=0;        Diabetes with complications;
neoplasia=0;    Neoplasia;
leukemia=0;     Leukemia;
lymphoma=0;     Lymphoma;
liverdz_modsev=0; Moderate or severe liver disease;
cancer_mets=0;  Metastatic solid tumor;
HIV=0;          HIV/AIDS

%MACRO CHECKDX(DX);
  DG3 = SUBSTR(&DX,1,3);
  DG4 = SUBSTR(&DX,1,4);
  SELECT;
  WHEN (DG3 in ('410','412')) AMI=1;
  WHEN (DG3='428') CHF=1;
  WHEN (DG3='441' OR DG4 IN ('4439','7854','V434')) PVD=1;
  WHEN (DG3 IN ('430','431','432','433','434','435','436','437','438'))
    CVD=1;
  WHEN (DG3='290') DEMENTIA=1;
  WHEN (DG3 IN ('490','491','492','493','494','495','496','500','501',
    '502','503','504','505') OR DG4='5064') COPD=1;
  WHEN (DG3 IN ('710','714','725')) CONN_TISSUEDZ=1;
  WHEN (DG3 IN ('531','532','533','534')) ULCER=1;
  WHEN (DG3 IN ('571')) LIVERDZ_MILD=1;
  WHEN (DX4 IN ('2504','2505','2506','2507','2508','2509')) DMWCC=1;
  WHEN (DX3 = '249' or DX4 in ('7915','9623','250 ','2500','2501',
    '2502','2503') or &DX in ('V5867','99657')) DIABETES=1;
  WHEN (DG3='342' OR DG4='3441') HEMIPLEGIA=1;
```

```
  WHEN (DG3 IN ('582','583','585','586','588')) CRF=1;
  WHEN (DG3 IN ('200','201','202','203','204')) LYMPHOMA=1;
  WHEN (DG3 IN ('205','206','207','208')) LEUKEMIA=1;
  WHEN (DG3 IN ('140','141','142','143','144','145','146','147',
    '148','149','150','151','152','153','154','155','156','157','158',
    '159','160','161','162','163','164','165','170','171','172','174',
    '175','176','179','180','181','182','183','184','185','186','187',
    '188','189','190','191','192','193','194','195')) NEOPLASIA=1;
  WHEN (DG4 IN ('5722','5723','5724','5728','4560','4561','4562'))
    LIVERDZ_MODSEV=1;
  WHEN (DG3 IN ('196','197','198','199')) CANCER_METS=1;
  WHEN (DG3 IN ('042','043','044')) HIV=1;
  OTHERWISE;
END;
%MEND;

%LET NEWVARS=%STR(AMIx CHFx PVDx CVDx DEMENTIAx COPDx
        CONNx_TISSUEDZx ULCERx   LIVERDZ_MILDx DIABETESx
        HEMIPLEGIAx CRFx DMWCCx NEOPLASIAx LEUKEMIAx
        LYMPHOMAx LIVERDZ_MODSEVx CANCER_METSx HIVx);

CHARL=SUM(OF &newvars)+(HEMIPLEGIAx+CRFx+DMWCCx+NEOPLASIAx+
        LEUKEMIAx+LYMPHOMAx)+2*(LIVERDZ_MODSEVx)+5*(CANCER_ME
        TSx+HIVx);

  output;
  END;
```

2. Chronic Conditions SAS code

```
  DX4=SUBSTR(&DX,1,4);
  DX3=SUBSTR(&DX,1,3);
  DXL=SUBSTR(&DX,5,1);
  IF DX4='4280' THEN CHF_CC=1;
  IF (('41400'<=&DX<='41407') OR
    ('41000'<=&DX<='41092') OR DX4 in ('4142','4143','4148','4149') OR
    ('4110 '<=&DX<='41189') OR
    ('4130'<=DX4<='4139') OR DX3='412') THEN CAD_CC=1;
  IF (DX3 IN ('496','492','493','494') OR DX4='4912') THEN
    RESP_CC=1;
  IF DX4='2500' or DX4='2490' THEN DIABWO_CC=1;
  IF ('2501'<=DX4<='2509' or '2491'<=DX4<='2499' or
    DX4 in ('7915','9623') or &dx in ('V5867','99657')) THEN DIABC_CC=1;
  IF (DX3='401') THEN HYPER_CC=1;
  IF (DX3='424') THEN VALV_CC=1;
  IF (DX3='425') THEN CARD_CC=1;
  IF (DX3 IN ('584','586')) THEN RENFAIL_CC=1;
```

```
  IF (DX4='4439') THEN PVD_CC=1;
  IF (DX3='272') THEN LIPID_CC=1;
  IF (DX3 IN ('427','426')) THEN DYS_CC=1;
  IF (DX3='290') THEN DEM_CC=1;
  IF ((DX3 IN ('434','433') & DXL='1') OR DX3='431' OR
    &DX='V1259') THEN STROKE_CC=1;
  IF (DX4 IN ('2504','4039','5811','5818','5819','5829','5939','5996','7100',
    '7531','7910') OR DX3 IN ('582','585') OR &DX='58381') THEN ACREN_CC=1;
  IF DX4='7865' then CHPAIN_CC=1;
  IF DX4 in ('5990','5999') THEN UTI_CC=1;
  IF DX3='285' THEN ANEMIA_CC=1;
  IF DX4='7807' THEN MALAISE_CC=1;
  IF (&DX IN ('78002','78009','78093','78097','78039') OR DX4 IN ('7802','7804'))
    THEN DIZZ_CC=1;
  IF DX3='719' THEN JOINT_CC=1;
  IF DX3='244' THEN THYROID_CC=1;
%MEND;

%LET CCDXLIST=%STR(CHF_CC CAD_CC RESP_CC DIABWO_CC DIABC_CC
        HYPER_CC   VALV_CC CARD_CC ACREN_CC RENFAIL_CC PVD_CC
        LIPID_CC DYS_CC DEM_CC   STROKE_CC CHPAIN_CC UTI_CC
        ANEMIA_CC MALAISE_CC DIZZ_CC JOINT_CC THYROID_CC);
```

3. Ambulatory Care Sensitive Conditions (ACSCs).

```
%LET ACSCLIST=%STR(ALL MENTAL ANEMIA ANGINA ASTHMA PNEU FLU
        CELL  COPD HF CONST DEHYD ARF HYPOK HYPON DIAB DIARR
        DIFFIC ENT HYPER  HYPOT HYPOG IMM STROKE NUTRI ULCER
        APPEND SEIZ SEPT SKIN PYEL UTI  FALL WLOSS TB);

%macro chkdx(diag);
  dx3=substr(&diag,1,3);
  dx4=substr(&diag,1,4);

ALL=1;
  IF '800'<=DX3<='839' OR DX3 IN ('850','851','852','853','854',
    '925','926','927','928','929') THEN FALL=1;
  IF DX4 IN ('7832','7833','7837') THEN WLOSS=1;
  IF DX3 IN ('011','012','013','014','015','016','017','018') THEN TB=1;

  IF DX4 IN ('5311','5312','5314','5315','5316','5330','5331','5310',
    '5320','5321','5322','5324','5325','5326',
    '5332','5334','5335','5336') THEN ULCER=1;
  IF DX4 IN ('540') THEN APPEND=1;
  IF DX3='345' OR &DX IN ('7803 ','78031','78039') THEN SEIZ=1;
  IF DX3='038' THEN SEPT=1;
  IF DX3 IN ('707') THEN SKIN=1;
```

```
IF DX4 IN ('5908','5900','5901','5909') THEN PYEL=1;
IF DX4 IN ('5950','5951','5952','5954','5959','5990') OR &DX='59589'
  THEN UTI=1;
IF DX4='2768' THEN HYPOK=1;
IF DX4='2761' THEN HYPON=1;
IF DX3 IN ('249','250') OR DX4 IN ('7915','9623') or
  &DX IN ('V5867','99657') THEN DIAB=1;
IF DX4 IN ('0030','0060','0061','5589') OR DX3 IN ('004','005','007',
  '008','009') OR &DX='78791' THEN DIARR=1;
IF &DX='00845' THEN DIFFIC=1;
IF DX3 IN ('382','462','463','464','465') OR DX4='4721'
  THEN ENT=1;
IF DX3 IN ('401','402','403','404','405') THEN HYPER=1;
IF DX3='458' THEN HYPOT=1;
IF DX3 IN ('032','033','037','045','055','072','390','391')
  THEN IMM=1;
IF &DX IN ('43301','43311','43321','43331','43381','43391',
  '43401','43411','43491') THEN STROKE=1;
IF DX3 IN ('260','261','262','263') OR DX4 IN ('2680','2681')
  THEN NUTRI=1;
IF DX4 IN ('2510','2511','2512') THEN HYPOG=1;
IF DX3 IN ('290','291','292','293','297','298') THEN MENTAL=1;
IF DX3 IN ('280','281') or dx4 in ('2852','2859') THEN ANEMIA=1;
IF DX3 IN ('411','412','413') THEN ANGINA=1;
IF DX3='493' THEN ASTHMA=1;
IF DX3 IN ('480','481','482','483','485','486') OR DX4='5070'
  THEN PNEU=1;
IF DX3 IN ('487','488') THEN FLU=1;
IF DX3 IN ('263','264','681','682','683','686') THEN CELL=1;
IF DX3 IN ('490','491','492','494','496') THEN COPD=1;
IF DX3 IN ('402','428') OR &DX IN ('40411','40413','40491',
  '40493','39891','5184') THEN HF=1;
IF &DX IN ('56039','56400','56401','56409') THEN CONST=1;
IF DX4 IN ('2765','2768') THEN DEHYD=1;
IF DX3 IN ('584','588') THEN ARF=1;

%mend;
```

4. Hospitalization, Emergency Room and Readmission Analytic Variables

To report descriptive statistics on the rates of ACSCs by location of service using claims files to create of rates of ACSCs by location of service: 1) inpatient; 2) hospital outpatient department or physician's office; and) ER/observation bed stays. For example, we will be examining the number of inpatient cellulitis admissions per 1,000 beneficiaries, the number of physician office/OPD visits per 1,000 beneficiaries, and the number of ER visits per 1,000 beneficiaries in the baseline, and the last 12 months of the intervention period.

A. Hospitalizations: Step 1 Combine transfer records as follows:

1. If the admission date (ADMSN_DT) or discharge date (DSCHRGDT) is missing on the claim, or equal to "0," set them equal to "from" (FROM_DT) and "through" (THRU_DT) dates, respectively.

2. Combine multiple claims that represent pieces of stays or transfers between hospitals, or separately administered units of a single hospital, into a single record representing a hospitalization. Some records in the Inpatient claims file that look like new admissions are actually transfers between or within facilities. This process uses all claims; do not exclude claims for periods if ineligibility until after the transfers have been processed.

    1. Create a claim type variable as CLMB_TYP = FAC_TYPE || TYPESRVC

    2. Sort the data by HICNO FROM_DT THRU_DT

    3. Designate the first record for each HICNO in the reference period as a new hospitalization.

    4. If the length between reference record discharge date and next admission date is more than one day, the next admission record is considered a new hospitalization.

    5. If the discharge status code of the reference record is not equal to 30, 02, 05, 61, or 62 and the status code of the record previous to the reference record is not equal to 30, 02, 05, 61, or 62, then the reference record is considered a new hospitalization. The definition of the discharge status codes are:
    30: Still a patient
    02: Discharged/transferred to other short term general hospital for inpatient care
    05: Discharged/transferred to skilled nursing facility (SNF)
    61: Discharged/transferred within this institution to a hospital-based Medicare-approved swing bed (1/1/02)
    62: Discharged to another IRF or IRF unit (1/1/02)

    6. If the discharge status code of the record previous to the reference record is equal to 30, 02, 05, 61, or 62 and the difference between the reference record's admission date and the record previous to the reference record's admission date is less than or equal to 1 day, then the reference record is considered a transfer.

    7. If the discharge status code of the reference record is equal to 30, 02, 05, 61, or 62 and the discharge status code of the record previous to the reference record is not equal to 30, 02, 05, 61, or 62, then the reference record is considered a new hospitalization.

    8. The length of stay is calculated, as described for the row 2 measure below. If the length of stay is negative, the record is removed.

9. The system counts each unique hospitalization falling within the reference period.

10. Note that admission dates that fall within the reference period are counted even if the discharge date falls outside of the reference period. Also note that, in some cases, the system will be missing the later pieces of a stay that commences within the period, especially when hospitals "split-bill" at calendar year-end, but the hospitalization will still be counted in the reference period.

B. Step 2: Create Causes of Hospitalization Analytic Variables: All cause and 34 ACSCs

1. All cause hospitalizations:
   Select if PDGNS_CD = any diagnosis code

2. Heart failure hospitalization:
   Select if PDGNS_CD = 428
   40201
   40211
   40291
   40401
   40411
   40491
   39891
   40403
   40413
   40493
   78550
   78551

3. Diabetes hospitalization:
   Select if PDGNS_CD = 250
   7915

4. Cellulitis:
   Select if PDGNS_CD = 681
   682

5. Asthma hospitalization:
   Select if PDGNS_CD = 493

6. COPD and Chronic Bronchitis
   Select if PDGNS_CD = 491
   492
   494
   496

7. Dehydration
   Select if PDGNS_CD = 2765

8. Bacterial Pneumonia
   Select if PDGNS_CD = 481
   482
   483
   485
   486

9. Septicemia
   Select if PDGNS_CD = 038

10. Ischemic Stroke
    Select if PDGNS_CD = 434
    436

11. UTI
    Select if PDGNS_CD = 5990
    5999

C. Emergency Room Visits, including observation stays

Calculate the number of beneficiary visits to a hospital's outpatient emergency room (ER) **or** for an observation stay during the reference period. Restrict the measure to ER and observation visits identified on the Outpatient (OPD) claims file. Keep records with a revenue center line item (REV_CNTR) equal to 045X or 0981 (emergency room care) unless the HCPCS for the line item equals 70000 through 79999 or 80000 through 89999 (thus excluding claims where only radiological or pathology/laboratory services were provided) for revenue code dates (REV_DT) that fall within the reference period. Keep records with a revenue center line item (REV_CNTR) equal to 0762 (treatment of observation room-observation room) for revenue code dates (REV_DT) that fall within the reference period. This will capture ER claims for beneficiaries that were not subsequently admitted to the hospital.

To capture ER visits that led to a hospitalization, claims are identified in the MedPAR (inpatient) file. Keep records with revenue center code values of 0450-0459, 0981, and 0762. The diagnostic emergency room details are on the inpatient claim.

Count each of the 10 types of ACSC visits for a unique beneficiary on a unique date. If a beneficiary has more than one visit on the same day, count them insofar as they are of different types. That is, no one can have more than one "all cause" visits on a given day; no one can have more than one CHF visit on a given day. A person can have a CHF visit and a CAD visit on the same day, however. Visit type is the same as for hospitalizations.

D. 30-day Hospital Readmissions

Each hospitalization within the reference period is eligible to be a readmission; that is, a single beneficiary can be counted more than once if she/he had more than one hospitalization during the period. Calculate all measures after handling transfers, as described in the hospitalization specifications. After identifying unique hospitalizations in the reference period, calculate the number of days between the admission date and the most immediate previous discharge date, if any, from a short-stay acute-care inpatient hospital department, for any reason, as identified in the Inpatient claims file. Flag as a 90-day readmit, if admission date is less than or equal to 90 days from date of discharge. The intervention period examined hospitalizations during the period from months 10-21 and included readmissions through the end of the demonstration period (month 24) for the Phase II original population. We constructed: all cause readmission rates for all hospitalizations and same cause readmission rates for the ten ambulatory care sensitive conditions.

a. All cause readmissions after all cause hospitalizations

b. Same cause readmissions for the 34 ACSCs.

2. Guideline Concordant Care

A. Quality of Care Variables

1) Diabetes beneficiaries

i. ***Denominator***: All beneficiaries with diabetes identified in the baseline period and at least one day of eligibility in both baseline and the demo period.

a. Rate of annual HbA1c testing – beneficiaries with diabetes in baseline (Alliance, NQF endorsed measure – exclusive of CPT II or LOINC codes for identification of test being performed).

ii. ***Numerator:*** Beneficiaries who have a claim for a test as defined by CPT codes in the physician and OPD file: 83036, 83037.

b. Rate of annual eye exam (retinal) as evidenced by an eye exam (codes below).

iii. ***Numerator:*** Beneficiaries who have a claim for a retinal or dilated eye exam by an eye care professional (optometrist (specialty = 41) or ophthalmologist (specialty = 18)). Refer to Table CDC-H for codes to identify eye exams.

Table CDC-H
Codes to Identify Eye Exams*

CPT	HCPCS	ICD-9-CM Procedure
67028, 67030, 67031, 67036, 67039-67043, 67101, 67105, 67107, 67108, 67110, 67112, 67113, 67121, 67141, 67145, 67208, 67210, 67218, 67220, 67221, 67227, 67228, 92002, 92004, 92012, 92014, 92018, 92019, 92134, 92225- 92228, 92230, 92235, 92240, 92250, 92260	S0620, S0621, S0625**, S3000	14.1-14.5, 14.9, 95.02-95.04, 95.11, 95.12, 95.16

c. Rate of annual low-density lipoprotein cholesterol (LDL-C) testing – beneficiaries with diabetes or ischemic vascular disease (Alliance, NQF endorsed for diabetes and NCQA, NQF endorsed for ischemic vascular disease – exclusive of CPT II or LOINC codes for identification of test being performed).

iv. ***Numerator:*** Beneficiaries who have a claim for a test as defined by CPT codes in the physician and OPD file: 80061, 83700, 83701, 83704, 83721.

d. Rate of annual medical attention for nephropathy - a nephropathy screening test or evidence of nephropathy

v. ***Numerator:***
- Beneficiaries with a nephropathy screening test (Table CDC-J);
- Beneficiaries with a claim with a code to indicate evidence of nephropathy (Table CDC-K); or

Table CDC-J
Codes to Identify Nephropathy Screening Tests

Description	CPT
Nephropathy screening test	82042, 82043, 82044, 84156

Table CDC-K
Codes to Identify Evidence of Nephropathy

Description	CPT	HCPCS	ICD-9-CM Diagnosis	ICD-9-CM Procedure
Evidence of treatment for nephropathy	36145, 36147, 36800, 36810, 36815, 36818, 36819-36821, 36831-36833, 50300, 50320, 50340, 50360, 50365, 50370, 50380, 90935, 90937, 90940, 90945, 90947, 90957-90962, 90965, 90966, 90969, 90970, 90989, 90993, 90997, 90999, 99512	G0257, G0392, G0393, S9339	250.4, 403, 404, 405.01, 405.11, 405.91, 580-588, 753.0, 753.1, 791.0, V42.0, V45.1	38.95, 39.27, 39.42, 39.43, 39.53, 39.93-39.95, 54.98, 55. 4-55.6

Description	UB Revenue	UB Type of Bill
Evidence of treatment for nephropathy	0367, 080x, 082x-085x, 088x	72X (ESRD Claims)

e. Annual rate of all four diabetes interventions

f. Annual rate of none of the four diabetes interventions

2) Rate of annual lipid panel testing for IVD beneficiaries

vi. ***Denominator***: All beneficiaries with IVD identified in the baseline period and at least one day of eligibility in both baseline and the demo period.

vii. ***Numerator:*** Beneficiaries with a complete lipid panel (Table IVD-D)

Table IVD-D
Codes to Identify a Complete Lipid Profile

Description	CPT
Lipid panel	80061

OR

Description	CPT
Total cholesterol	82465
AND High density lipoprotein (HDL)	83701
AND Triglycerides	84478