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

Final Report

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EVALUATION OF THE EXTENDED MEDICARE CARE MANAGEMENT FOR HIGH
COST BENEFICIARIES (CMHCB) DEMONSTRATION: HEALTH BUDDY® WEST
PROGRAM

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CHAPTER 1

INTRODUCTION TO THE MEDICARE CARE MANAGEMENT FOR HIGH COST BENEFICIARIES (CMHCB) DEMONSTRATION AND THE HEALTHY BUDDY[®] WEST PROGRAM

1.1 Background on the CMHCB Demonstration and Evaluation

The purpose of this report is to present the findings from RTI International's evaluation of Robert Bosch Healthcare Systems, Inc.'s (RBHC) Care Management for High Cost Beneficiaries (CMHCB) Demonstration program referred to as the Health Buddy[®] Program. On July 6, 2005, the Centers for Medicare & Medicaid Services (CMS) announced the selection of six care management organizations (CMOs) to operate programs in the CMHCB Demonstration. These programs offered a variety of models, including "support programs for healthcare coordination, physician and nurse home visits, use of in-home monitoring devices, provider office electronic medical records, self-care and caregiver support, education and outreach, behavioral health care management, and transportation services" (CMS, 2005).

The principal objective of this demonstration was to test a pay-for-performance contracting model and new intervention strategies for Medicare fee-for-service (FFS) beneficiaries, who are high cost and/or who have complex chronic conditions, with the goals of reducing future costs, improving quality of care and quality of life, and improving beneficiary and provider satisfaction. The desired outcomes included a reduction in unnecessary emergency room visits and hospitalizations, improvement in evidence-based care, and avoidance of acute exacerbations and complications. In addition, this demonstration provided the opportunity to evaluate the success of the "fee at risk" contracting model, a relatively new pay-for-performance model, for CMS. This model provided the CMOs with flexibility in their operations and strong incentives to keep evolving toward the outreach and intervention strategies that are the most effective in improving population outcomes.

The overall design of the CMHCB Demonstration followed an intent-to-treat (ITT) model, and the CMOs were held at risk for their monthly management fees based on the performance of the full population of eligible beneficiaries assigned to their intervention group and as compared with all eligible beneficiaries assigned to their comparison group. Beneficiary participation in the CMHCB Demonstration was voluntary and did not change the scope, duration, or amount of Medicare FFS benefits received. All Medicare FFS benefits continued to be covered, administered, and paid for by the traditional Medicare FFS program. Beneficiaries did not pay any charge to receive CMHCB Demonstration program services.

The CMOs received from CMS a monthly administrative fee per participant, contingent on intervention group savings in Medicare payments being equal to fees paid to the CMO plus an additional 5% (or 2.5%) savings calculated as a percentage of its comparison group's Medicare payments. CMS developed the CMHCB Demonstration with considerable administrative risk as an incentive to reach assigned beneficiaries and their providers and to improve care management. If the CMOs were able to achieve net savings beyond the noted financial requirements, they would share with CMS the additional savings.

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 (MGH) Care Management Program (CMP); and Robert Bosch Healthcare Systems, Inc.'s (RBHC) Health Buddy[®] Program. CMS also allowed RBHC to expand its Health Buddy[®] Program to Montefiore Medical Center in New York.

RTI International was hired by CMS to be the evaluator of the CMHCB Demonstration and has previously reported to CMS findings from Phase I (McCall *et al.*, 2011). 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 (WVMC) in Wenatchee, Washington and Bend Memorial Clinic (BMC) in Bend, Oregon. The Health Buddy[®] West program was delivered by a consortium of four organizations collaborating to deliver care management services to high-cost Medicare beneficiaries with a range of chronic conditions: WVMC, BMC, RBHC, formerly Health Hero Network, and the American Medical Group Association (AMGA).

The overarching goal of the program was to demonstrate that multi-specialty medical groups, applying a consistent model of care management augmented by an integrated technology solution, were uniquely positioned to improve the lives and reduce the costs associated with high-cost beneficiaries insured by traditional Medicare fee-for-service. WVMC and BMC were considered one program within the Health Buddy[®] Consortium in which Care Managers used the Health Buddy[®] device (a small, tabletop computer that resided in participants' homes and connected to RBHC servers via Ethernet, cellular modem, or a telephonic landline) 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.

WVMC's Phase I care management program included diabetes, heart failure, chronic obstructive pulmonary disease (COPD), as well as coronary artery disease, and hypertension as co-morbidities. The collection of conditions/topics covered expanded during the extension period with the addition of Health Buddy[®] dialogues for the following topics: asthma, diabetes, chronic pain, depression, and senior wellness. BMC offered Health Buddy[®] dialogues for the following topics: asthma, coronary artery disease, cancer, hypertension, diabetes, chronic pain, COPD, senior wellness, healthy heart, and heart failure. Since many participants had multiple comorbidities, Care Managers could assign multiple dialogues for a participant. The programs used by each site were chosen by the site based on the composition of its beneficiary population.

RTI conducted two site visits to the Health Buddy[®] West program at WVMC and BMC during the original demonstration period in 2006 and 2008, and two during the extension period in 2009 and 2011. Two RTI evaluation team members participated in each site visit. During the initial extension period site visit on October 6, 2009, RTI staff met with representatives from RBHC, clinical and managerial staff from WVMC, and a representative of AMGA. RTI staff also conducted a telephone conference call with RBHC and BMC staff on October 15, 2009. The interviews included a range of questions related to program implementation, performance monitoring/outcomes, and implementation experience/lessons learned to date.

The second site visit included an in-person visit to WVMC in Wenatchee, Washington, on February 15, 2011, during which RTI staff interviewed clinical and managerial staff from WVMC and RBHC and conducted two focus groups with patients participating in the Health Buddy[®] West program and their caregivers. The focus groups included a total of thirteen patients and two caregivers. RTI also conducted a telephone conference call with clinical and managerial staff from BMC and RBHC on March 14, 2011.

This final report presents evaluation findings of the Health Buddy[®] West program with their Phase I and Phase II original and refresh populations during the extension period, as well as summary information obtained from the site visits and the program close out calls conducted by telephone with key Health Buddy[®] West staff from WVMC, BMC, and RBHC in March 2012.

1.2 Organizational Characteristics

Physician Practices: Wenatchee Valley Medical Center and Bend Memorial Clinic. WVMC is the second largest multi-specialty group practice in the Pacific Northwest, employing over 170 physicians who staff over 50 different clinical departments. WVMC was interested in the CMHCB Demonstration as a way to decrease multiple hospitalizations among patients with chronic illnesses, expand its case management programs, offer the Health Buddy[®] technology to its patients, and replicate the care model in its various clinics.

Located in Bend, Oregon, Bend Memorial Clinic (BMC) is the largest multi-specialty group practice in Central Oregon with 100 healthcare providers providing care in 30 specialties. Prior to this project, BMC had been interested in implementing a care management program, but had not participated in a formal disease management program and had limited experience with performance monitoring. BMC viewed the CMHCB Demonstration as an opportunity to benefit from support provided by the Health Buddy[®] Consortium to gain experience implementing care management systems and protocols, establish associated workflows, and offer the Health Buddy[®] to its most ill patients, a tool that BMC believed would help these individuals.

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 2007, RBHC acquired Health Hero Network, the developers of the Health Buddy[®] device, and transitioned into the Phase I demonstration program with the two clinical partner sites, WVMC and BMC.

American Medical Group Association. AMGA is a professional organization that advocates for the multi-specialty group practice model of health care delivery and for the patients served by medical groups. During Phase I, AMGA assisted with management of the relationships with the two partner medical groups, as well as with CMS. During Phase II, AMGA served in a consultative role.

1.3 Market Characteristics

Central Oregon and central Washington are primarily rural areas where the population is widely dispersed over a large geographic area. Approximately 40% of the population qualifies for Medicare, and the elderly populations in these areas are growing. Healthy retired persons are

attracted to this region to enjoy the extensive recreational opportunities. A significant proportion of the elderly are “snowbirds”—spending 6 months each year in the Northwest and 6 months in warmer states, such as Arizona, California, Florida, or Hawaii. There is also a large population of Medicare beneficiaries with chronic illnesses who is attracted to the area for its existing health care infrastructure and/or the presence of family members to provide care. The populations of both states are approximately 80% White and 8% Hispanic.

BMC has a close relationship with a nearby hospital, St. Charles Medical Center, and many of BMC’s physicians have admitting privileges at this facility. WVMC operates its own 21-bed hospital and has a strong relationship with Central Washington Hospital. WVMC reported that its service area and surrounding areas are characterized by significant access to care problems due to a shortage of physicians and poor public transportation access. In addition, some specialists have begun turning away Medicaid patients; as a result WVMC often serves as a provider of last resort seeing patients who live more than 3 hours from its facility. Overall, the region has a low penetration of managed care.

1.4 The Health Buddy[®] West Intervention and Comparison Populations

Intervention population. In addition to the Phase I Original and Refresh populations, Health Buddy[®] West added a Phase II population. Inclusion criteria for eligibility included:

- Medicare FFS beneficiaries that lived in the counties designated by RBHC as of January 12, 2009 and who had claims during the base period (August 1, 2007 through July 31, 2008).
- Beneficiaries who met the diagnostic criteria and utilization thresholds for Phase II. The Health Buddy[®] West criteria specified that beneficiaries were eligible only if they had one or more claims during the base period that 1) corresponded to the Tax Identification Numbers (TINs) for a Health Buddy[®] West clinic, and 2) matched at least one specified ICD-9-CM target diagnosis code.
- Absence of selected conditions as indicated by ICD-9 diagnosis codes and DRG codes obtained from claims data, including dementia, substance abuse, and schizophrenia.
- Two or more evaluation and management (E&M) visits or a plurality of E&M visits to one of the Health Buddy[®] West clinics during the baseline period.

The population was further restricted using the following exclusion criteria based on a January 12, 2009 Medicare Enrollment Data Base (EDB) check of beneficiary status or from Medicare claims data:

- age less than 18,
- receiving the Medicare hospice benefit,
- receiving the Medicare end-stage renal disease (ESRD) benefit,

- history of dialysis treatment and/or kidney transplant,
- enrolled in a Medicare Advantage (MA) plan,
- Medicare as a secondary payer, or
- no Medicare Part A or Part B coverage.
- death (date of death recorded on EDB as of January 12, 2009).

Using these criteria, the Phase II population consisted of 2,169 Medicare FFS beneficiaries. One issue that had to be handled in the selection of the Phase II population is that the characteristics of the beneficiary population is dynamic, so that those determined eligible using EDB data as of January 12, 2009 may have lost eligibility during the baseline analysis period. Therefore, the 2,169 loyal beneficiaries were re-screened for eligibility as of April 2, 2009 which yielded 2,089 beneficiaries eligible for the Phase II intervention population. In addition, the Health Buddy[®] West Program 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 April 2, 2009. A total of 427 Phase I Original population beneficiaries and 741 Phase I Refresh population beneficiaries were transitioned into the Phase II Health Buddy[®] West Program.

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. Much of the selection process closely parallels the procedures used to choose the Phase I populations in the two states, with the exception of using cost and HCC risk score thresholds to determine eligibility. The Phase II comparison group was selected using the following eligibility criteria.

- Medicare beneficiaries living in the comparison counties in Oregon and Washington who had claims between 8/1/07 and 7/31/08. The comparison counties were the same (9 in Oregon and 12 in Washington) as those used in Phase I.
- Beneficiaries who met the diagnostic criteria and utilization thresholds for Phase II. The Health Buddy criteria specified that beneficiaries were eligible only if they had one or more claims during the base period that 1) corresponded to the Tax Identification Numbers (TINs) for a comparison TIN, and 2) matched at least one specified ICD-9-CM target diagnosis code.
- Absence of selected conditions as indicated by ICD-9 diagnosis codes and DRG codes obtained from claims data, including dementia, substance abuse, and schizophrenia.
- Two or more E&M visits or a plurality of E&M visits billed by a designated comparison TIN.

The exclusion criteria that were applied to the intervention group were also used to limit the comparison group (i.e., age less than 18, receiving the Medicare hospice benefit, receiving the Medicare ESRD benefit, history of dialysis or kidney transplant, enrolled in an MA plan, Medicare as a secondary payer, lack of Medicare Part A or Part B coverage or died as of January 12, 2009), and potential comparison group beneficiaries participating in other demonstrations were also deleted. Determination of eligibility was made as of January 12, 2009.

The matching process for Phase II was more complicated than the process for Phase I due to the addition of two new target conditions (asthma and Ischemic Heart Disease (IHD)) to the original list. Many beneficiaries have more than one condition. In Phase I, the four target conditions produced 9 different configurations involving one or more conditions. In Phase II, the number of configurations increased dramatically with the addition of the two new conditions. We determined all of the configurations occurring in the intervention and comparison groups, and matched the groups on each configuration. As a result of this one-to-one matching, the Phase II comparison group was exactly the same size as the intervention group in both Oregon (791 beneficiaries) and Washington (1,298 beneficiaries). The Phase I Original comparison population that transitioned to Phase II consisted of 405 Medicare FFS beneficiaries; while the Phase I Refresh comparison population consisted of 715 Medicare FFS beneficiaries. Eligibility was determined as of April 2, 2009.

1.5 Overview of the Health Buddy[®] West Care Management Program

The Health Buddy[®] West program managed the care of Medicare beneficiaries with chronic diseases using a model in which Care Managers used the Health Buddy[®] device to receive qualitative and quantitative information from beneficiaries on a daily basis. Each day, a flashing light on the Health Buddy[®] device reminded participants to check in. Participants received information and quizzes about their conditions and submitted clinical data, such as weight and blood pressure, using the Health Buddy[®] device in daily sessions that spanned 5 to 10 minutes. Each device was programmed with a disease-specific program, or in some instances, programs that addressed comorbid conditions, such as COPD and diabetes. The Health Buddy[®] disease management content was drawn from evidence-based practice guidelines, and each dialogue was designed to collect standard outcome measures including utilization, patient satisfaction, quality of life, and compliance with treatment regimens. Advisory boards at each of the participating medical practices reviewed the Health Buddy[®] dialogues and developed associated care protocols and care plans to guide Care Managers' responses to alerts associated with each disease-specific dialogue.

Individuals without a chronic condition reviewed a Senior Wellness dialogue that addressed issues related to general health and safety, as well as psychosocial issues, such as depression. Patients who were unable or unwilling to use the Health Buddy[®] device had the opportunity to participate in the Health Buddy[®] program through routinely scheduled telephone calls with Care Managers that occurred weekly, bi-weekly, or monthly depending on the patient's health status. This was referred to as the "Alternate Program."

Care Managers used the Health Buddy[®] desktop, a web-based application, to monitor participant responses to surveys conducted via the Health Buddy[®] device, and followed up with participants to help them to address issues and initiate interventions, as needed, to maintain their

health. Routine monitoring of participant health status and symptoms through risk stratification of participant responses alerted Care Managers to health issues that required early intervention, ideally before those issues resulted in serious complications that require hospitalization. The goals of the intervention were to improve the overall health of program participants and to decrease the frequency of acute exacerbations of chronic disease and associated hospitalizations and emergency room visits (as well as related acute-care utilization).

Physician Support Services. The Health Buddy[®] West program provided physicians with information about patient symptoms, vital signs, and behaviors during the time period between office visits. As a result, providers had the opportunity to intervene with patients when they experienced early symptoms of health problems, potentially avoiding hospitalizations or emergency room visits. Further, physicians could review trends in patients' Health Buddy[®] device responses prior to scheduled office visits, which could help them to identify health issues that required attention.

Physicians at both sites reported that they were initially very enthusiastic about the Health Buddy[®] program because it offered a promising way to effectively support patients with chronic disease. The Health Buddy[®] technology coupled with telephonic care management support was viewed as an effective way to maintain and improve patient health and identify symptoms of complications early, so that timely medical intervention could be used to prevent serious problems requiring hospitalization. However, once the physicians received the list of patients who were eligible for the Health Buddy[®] program, some reported feeling frustrated that many of the patients selected would not benefit from participating. Further, physicians reported disappointment that many of the patients they believed could be helped by the program were not eligible to participate in the program because they had not been identified through the claims-based selection algorithm.

1.5.1 Programmatic Changes Implemented During the Extension Period

The Health Buddy[®] West program continued to evolve and implement programmatic changes during the extension period, including: customization of Health Buddy[®] dialogs for patients with multiple comorbidities; release of the HB3, a new model of the Health Buddy[®] device; embedding of Care Managers; enhanced patient and provider outreach efforts; and expanded recruitment efforts.

Customization and Addition of New Health Buddy[®] Dialogs. Care Managers recognized early in the demonstration that the targeted conditions that qualified beneficiaries to participate were not necessarily the conditions that posed the greatest day-to-day challenges to beneficiaries. As a result, WVMC and RBHC collaborated to improve the content of the individual dialogs and to increase the number of programs available to participants, particularly those with multiple comorbidities. Examples of Health Buddy[®] combination dialogs that were added during the extension period included: diabetes, heart failure, and COPD; asthma and COPD; senior wellness, heart failure, and diabetes; and diabetes and depression.

Care Managers reported that they were able to maintain participant interest in the program by switching to different Health Buddy[®] dialogs and enabling them to learn additional material related to their comorbid conditions beyond the repetition of material designed for their

primary condition. Participants were generally assigned to dialogs for 360 days at a time. If necessary, Care Managers could work with RBHC staff to tailor programs for a participant by creating specific variables. Select programs were also available in Spanish. Care Managers reported that overall, participants were very interested in the Health Buddy[®] trivia questions and clinical information embedded in the programs and appreciated the newly acquired knowledge.

Introduction of the HB3 Health Buddy[®] Device and Cellular Modems. During the extension period, RBHC released the HB3, an Ethernet-enabled model that allowed participants with bundled services for TV, DSL and phone to connect through Ethernet. Although Care Managers appreciated the enhanced features and content of the device, challenges pertaining to installation of the device accompanied the enhancements. Care Managers spent a great deal of time troubleshooting problems with installation, sometimes requiring program staff to make home visits to correct technical issues. Cellular modem devices were deployed with the HB3 in May 2010 for patients without a land-line. This resulted in the recruitment of patients who previously would not have enrolled and also facilitated the transition of Alternate Program patients into Health Buddy[®] reporting. Staff at both sites indicated that the new cellular modem model was easy to install and easy to use.

Embedding of Care Managers. Over the course of the demonstration period, both sites added Care Managers (described in greater detail in the Staffing and Management section) and made concerted efforts to embed and more fully integrate Care Managers in the clinic setting based on findings from Phase I. In some practices, Care Managers scheduled patient-physician visits. At the time of the second site visit during the extension period, WVMC program staff indicated that the majority (60-70%) of the patient caseload had transitioned to embedded (clinic-based) Care Managers. The remaining patients were serviced by providers outside of the WVMC clinics system that shared Care Managers.

Enhanced patient and provider outreach efforts. BMC expanded provider outreach efforts, including a presentation given to the medical staff by the WVMC Health Buddy[®] West Medical Director and Care Management Lead and a provider luncheon and dinner to generate greater program awareness and develop physician support. The program also held three Wellness Days that included educational workshops for patients based on WVMC's success with the initiative in simulating beneficiary interest and participation.

Use of Health Contact Partners to Conduct Recruitment and Additional Outreach Efforts. RBHC contracted with Health Contact Partners to conduct telephone recruitment of beneficiaries for both WVMC and BMC. The primary responsibility of Health Contact Partners was to initiate telephone contact with beneficiaries after receiving the first recruitment letter and to schedule an orientation appointment for eligible non-participants to enroll in the program. However, by the time of the second site visit, BMC had transitioned to a more active role in engagement by largely bringing enrollment calls in-house. Although BMC program staff stated that they may not have placed as many calls per day as Health Contact Partners, they reported having a greater success rate in recruiting program participants.

As another means of enhancing outreach efforts, RBHC produced a new promotional DVD that was included with the recruitment packets and shown at the enrollment/orientation sessions. Care Managers felt that the DVDs were effective in encouraging beneficiary

enrollment. Additionally, WVMC created a tri-fold brochure that explained the services provided to program participants.

1.6 Staffing and Resources

At the time of the first site visit during the extension period, WVMC's Health Buddy[®] West program employed 3.8 FTEs (one full-time and four part-time RN Care Managers) as well as a per diem registered nurse responsible for touching base with participants on the Alternate Program list once a month. Site visit participants reported having no issues with Care Manager turnover or retention and added two RN Care Managers during the extension period. They also noted that embedded Care Managers added value by serving as another point of access in the office for the patient; improving patient access to the physician; and providing valuable, specific knowledge about the patients. It was reported that physicians often referred to the information provided by Care Managers in trend reports or other communications about the patient when dictating patient progress notes.

At the beginning of Phase II, BMC's Health Buddy[®] West program employed one full-time Care Manager with supplemental assistance provided by staff from other departments to help with daily monitoring, beneficiary coordination, phone calls, and recruitment mailings. As program enrollment grew, the Care Manager transitioned to the role of Program Lead and the program hired two part-time Care Managers who only lasted one month each due to medical reasons and a Care Manager's change in career direction. BMC eventually hired a full-time Care Manager to focus on managing the caseload with support from the Program Lead. For example, while the Care Manager began daily monitoring tasks, the Program Lead reviewed the non-responder list and prioritized those requiring calls. Either team member interacted with physicians if they felt that a patient required a clinic visit that day.

WVMC, BMC, and RBHC felt an ethical obligation to continue serving high-risk Health Buddy[®] West beneficiaries at no charge to participants, and to ensure that they had a safety net beyond the extension period. WVMC identified high-risk patients early in 2012 based on factors such as multiple medication changes in the past year, frequent physician visits, increased hospitalization, and Care Manager knowledge of the patient. Fifty patients were selected to continue on the program and at the time of the closeout call, 38 patients remained in the intervention. In an effort to preserve Care Manager-patient relationships, WVMC chose to maintain the same Care Managers for participants rather than assigning the patients to one Care Manager.

Toward the end of the demonstration, BMC staff identified beneficiaries who were high risk of clinical deterioration and allowed them to use the Health Buddy[®] device for an additional year. RBHC agreed to provide the Health Buddy[®] device free of charge during the one year wind-down period. At the time of the closeout call, BMC covered the salary of one full-time Care Manager and provided services to 24 active Health Buddy[®] users who would gradually phase out of the program. In addition, six Alternate Program patients continued to have interactions with the Care Manager. In an effort to conserve resources, BMC, like WVMC, changed their quarterly trend reports from automatic to physician request, which improved workflow and provided more timely information to physicians.

1.7 Changes in Other Aspects of the Extended Health Buddy® West Program

In addition to a series of changes and enhancements to program operations, we also discussed other aspects of the program pertaining to:

- Comparison of characteristics of the Phase II population and Phase I legacy population
- Relationships with local program partners
- Relationships between WVMC, BMC, AMGA, and RBHC
- Relationship with CMS
- Changes in corporate support for the Health Buddy® West program

1.7.1 Comparison of Characteristics of the Phase II population and Phase I Legacy population

Both the WVMC and BMC program staff indicated that their Phase II eligible beneficiaries were more appropriate than their initial Phase I eligible beneficiaries, which included a large number of patients with inaccurate diagnoses. Some of the WVMC Care Managers did not feel that the Phase II participants were as sick as those included in the first Phase I Refresh population and identified COPD and reactive airway disease or asthma as common diagnoses among their elderly beneficiaries. They characterized their patient population as a wide spectrum that included healthy patients, those with well-controlled chronic diseases, and those requiring day-to-day management (with the assistance of the Health Buddy® device).

Site visit participants from both sites noted that providers would like to have had a greater degree of flexibility in being able to handpick patients they thought were appropriate for the program and who would benefit most. Program staff conveyed to the providers that the nature of the demonstration program stipulated eligibility criteria and physicians, in general, understood this de facto condition.

BMC staff reported that their Phase I Original and Refresh populations were subject to review and carve-outs due to incorrect or inaccurate diagnoses. BMC's beneficiary population was somewhat unique in that many retirees lived in the Bend area during the summer and lived elsewhere during the winter. This was a challenge since not all program participants could or wanted to take their Health Buddy® device with them when they traveled, thereby making follow-up a constant issue. For half the year, these participants could join the Alternate Program since they only had their cell phone with them. Some participants consistently traveled to the same area, established a relationship with their provider, and sent their provider's contact information to BMC's Program Lead.

Many of BMC's patients were frail elderly without family nearby to help with their medications, diet, or activity and as a result, family members may not have recognized when their loved one's health status was worsening or when it was appropriate to contact their

provider. Program staff felt that these participants benefitted the most from the intervention and were the easiest to keep actively engaged because they viewed the program as a benefit.

1.7.2 Relationships with Local Program Partners and Community Organizations

Relationship with Local Program Partners. Internally, WVMC Health Buddy[®] program staff met with nurses and medical assistants from medical offices as well as the staff from Wenatchee Valley Hospital to inform them about the Health Buddy[®] program. Program staff noted better access to the local hospital's new EMR during the second site visit. They observed an improvement in the identification of Health Buddy[®] patients from the census list and the ability to contact them while still in the hospital or immediately upon return to home. This allowed the opportunity to confirm that any transition of care issues, such as follow up appointments, labs, and medication reconciliation, were resolved.

WVMC's Health Buddy[®] West Medical Director established a contract with Central Washington Hospital in 2011 that enabled WVMC Care Managers to receive a weekly list of Health Buddy[®] West beneficiaries that were seen or admitted to the hospital. The Medical Director also worked with other area hospitals to try and obtain a similar agreement.

BMC program staff was able to obtain read-only access to the hospital EMR for patients enrolled in or eligible for the program. Although they were unable to copy any of the records for Health Buddy[®] use, they could view patient admission and emergency room (ER) records for names that were entered. They were not notified of patient admissions or ER visits.

Relationship with Community Organizations and Other Care Entities. Both BMC and WVMC reported that they maintained good working relationships with local community organizations and home health agencies as community awareness of the program expanded. WVMC program staff continued to make referrals and interact with community groups such as, Aging and Adult Care of Central Washington, local home health services, transportation services, and the public health department to link participants with needed services. However, they found that budget cuts eliminated many of the previously provided services and that some of the people with whom they made initial contacts were no longer employed with the departments, making it more challenging to facilitate referrals at times.

BMC continued to improve relationships with local community agencies and often used the senior center as a community resource and referred program participants to local social service agencies as requested or needed. Staff members felt that their effort to enhance relationships with community partners and BMC physicians and staff facilitated patient retention and satisfaction.

1.7.3 Relationships Among WVMC, BMC, AMGA, and RBHC

The WVMC and BMC program managers, AMGA representative, and RBHC program staff convened in San Francisco for a summit meeting in January 2010. The meeting provided an opportunity for information sharing and problem solving. WVMC staff also traveled to Bend for presentations in late June 2010, which facilitated the development of a closer working relationship between the physicians of the programs. WVMC, BMC, and RBHC participated in biweekly meetings, which staff felt facilitated communication and information sharing. RBHC

staff reported participating in several activities to support site meetings, enhance recruitment efforts, facilitate information sharing, including: physician group meetings; individual physician meetings; clinic staff meetings; educational workshops; seasonal newsletters ; and development of revised outreach telephone scripts.

During Phase I, AMGA assisted with management of the relationships with the two partner medical groups, as well as with CMS. During Phase II, however, AMGA's role transitioned to one that was more consultative in nature in that AMGA no longer assumed risk associated with the program and also no longer received a per member per month payment as they did during Phase I.

WVMC collaborated with RBHC to develop other Health Buddy[®] projects across the country. Discussions were ongoing concerning use of the Health Buddy[®] device with WVMC's own managed care group within the clinic and with Premera Blue Cross beneficiaries. BMC program staff indicated that they continued to depend on RBHC program leaders for program support, clinical programming, troubleshooting, and facilitating a few communication and outreach activities. RBHC noted that their relationship with the clinics settled into a "nice working rhythm."

1.7.4 Relationship with CMS

Health Buddy[®] West program staff did not like the change that was made in Phase II with respect to beneficiary eligibility for the demonstration. In Phase I, if a participant became ineligible and then became eligible, he/she could rejoin the program. However, in Phase II this policy changed such that once a participant became ineligible, he/she was no longer able to rejoin the program should he/she regained eligibility. Site visit participants felt that this policy impeded their ability to engage patients for longer periods of time.

Relationship-wise, however, WVMC program staff reported no changes in their relationship with CMS. BMC relied upon RBHC program managers to maintain and develop relationships with CMS. RBHC site visit participants reported that the involvement of Dr. Karen Gilberg and Karen Flores as primary contacts with CMS enhanced communication with the Health Buddy[®] CMS team.

1.7.5 Corporate Support for the Health Buddy[®] West Program

WVMC program staff maintained a partnership with both internal and external medical staff throughout the course of the program. As the program evolved and credibility was established among the physicians, staff noted an increase in the level of collaboration. The Care Managers received copies of progress notes from physicians when they saw a Health Buddy[®] participant. The progress notes referred to the Care Managers' interventions, trend reports sent by the Care Managers, and instances in which the Care Managers averted a hospitalization or influenced changes to medications based on feedback on participant symptoms. One WVMC physician leader noted that traditionally, the healthcare system waits for patients to have an event or issue and subsequently treats the patient for that problem. As opposed to the more traditional allopathic model in which physicians are trained to primarily deal with acute problems, the Health Buddy[®] device and Care Manager together functioned as a constant maintenance arm for

preventive care. He viewed the Care Managers embedded within the clinic as part of the clinical team with the physicians.

Strategically, WVMC leadership viewed the Health Buddy[®] West program as a means of providing adequate access to beneficiaries given an insufficient number of physicians to care for patients through traditional means. They indicated that the program allowed WVMC to provide a higher level of care to more patients in a more efficient manner. WVMC site visit participants felt that administration recognized the potential benefits of Care Managers. BMC program staff reported that corporate support grew as positive outcomes of the program were increasingly recognized by providers and administrators. RBHC site visit participants stated that RBHC increased program support by adding account staff to address information systems, development and support, clinical leadership, clinical content development, and account management.

1.8 Perceived Participant Benefits from the CMHCB Demonstration

Care Managers at BMC and WVMC believed that participants in their clinics benefited from the relationships they developed with their Care Managers. The Care Managers took pride in knowing that they frequently prevented unnecessary hospitalizations and ER visits through patient education. They also felt that program participants appreciated the ability of Care Managers to facilitate access to care and obtain immediate appointments with their physicians when necessary.

Because of the repetitive nature of the Health Buddy[®] dialogues, Care Managers felt that the majority of participants who used the Health Buddy[®] device learned to manage their conditions and over time, required less intervention by the Care Managers. For example, a Care Manager described a developmentally delayed participant who, prior to using the device, would not have gone to see a doctor when it was necessary. However, he faithfully answered the questions on his device daily and when he had an incident that required medical attention while the Care Manager was on vacation, the participant went to the doctor. Participants reported improvements to Care Managers that included:

- Knowing what to do or whom to call when a situation required medical attention.
- Knowing when to adjust their medication or adjust other things within their control without consulting Care Managers, doctors' nurses, or doctors.
- Knowing when to call the doctor versus when to see the doctor.
- Knowing when to go to the ER.
- Experiencing an increased sense of independence and confidence in their own abilities to manage their conditions and their health in general.
- Experiencing improved mood and health status.
- Losing weight and weaning off of multiple cardiac and diabetic medications.

The Care Managers did note a few challenges. Some participants had a false sense of how stable their health was upon taking medications or having procedures performed to alleviate or rectify a health problem. The Care Managers specifically noted that some chronic heart failure participants were in renal failure and did not always realize the gravity of their condition.

Distance was another challenge noted by the WVMC Care Managers. It was challenging to staff full-time Care Managers in some of the remote sites where there were 100+ miles in between areas. As a result, the program resorted to employing part-time Care Managers.

Care Managers also noted the following observations about the program:

- WVMC Care Managers reported that it was easier to enroll patients of WVMC physicians (versus non-clinic physicians) in the program because patients were already familiar with the clinic and were more willing to participate when they heard that their physician was supportive of the program. Physicians outside of the clinic were not always as supportive or enthusiastic about the program. Rather than initially sending letters to some of the primary care physicians outside of the system, for some beneficiaries, the Care Managers sent a letter to a specialist within the system who saw the beneficiary.
- The Health Buddy[®] device helped Care Managers prioritize participants that required a follow-up and allowed them to manage a larger patient population without having to conduct a detailed review of medical records.
- The ability to give providers comprehensive trend reports on their patients provided clinicians with valuable insight on their patients' conditions and may have enabled the physician to intervene more appropriately.
- Care Managers believed the intervention was more successful with the Health Buddy[®] device than without (i.e., management by Care Managers without the device).
- Care Managers believed the intervention was more effective when a program participant had a personal relationship with a Care Manager (as opposed to care management performed by a call center staffed by nurses without a personal relationship with program participants).
- The ability to access EMRs enhanced the effectiveness of management provided by Care Managers; however, care management could still be provided without access to EMRs.

Physicians appreciated the earlier knowledge they received about their patients' medical conditions. It was particularly useful when there was a sudden deterioration in the patients' condition because it allowed providers to contact patients and intervene appropriately and in a timely manner.

“I don’t like when my patients end up in the hospital and if I can prevent it, I feel personal satisfaction with their treatment.”

“Any help is greatly appreciated because we really have limited time to teach...the more teaching folks can get and the more repetition, the better.”

Physicians heard anecdotally from patients that they felt the program helped them maintain focus on their condition and that they liked the reassurance they received that things were going okay.

Participants were reassured and took great comfort in knowing that there was a human being on the other end of the Health Buddy[®] device to check in on them.

Where I was living, I was by myself and this was my contact with people. I knew that if I didn’t call within three days, that they would call me and there were several times when I was ill and it was a wonderful thing.

I like the program because I feel I am not going to fall through the cracks.

I feel like it takes the place of a family close by that would do something for me and it is reassuring to know.

...Even when you feel like you’re out there all by yourself, that blinking light tells you you’re not. When they call, you know you’re not just following some dumb exercise, they’re calling for a real purpose.

Participants also felt that the Care Managers facilitated access to care and communication with providers.

It really is a marvelous program and I would highly recommend it. My case worker calls me about once a month if I don’t call her. They are the only way you can get in to see a doctor actually. If you are really ill, they will get you in and pull strings and my doctor realizes they are an asset.

If they have to call for an appointment, my doctor will call me right away and want to know what is going on. Before, it was two weeks before you could see a doctor and it was an emergency. They are not shy at getting you an appointment...that is a wonderful part of it.

It reassures me that I am going to have the care I need when I need it.

I think the doctor has better information on us. He has the blood pressure and blood sugar and it is laid out for several months. It is a better picture for him.

And, participants valued the knowledge and education provided and felt that the program encouraged participants to do a better job of monitoring of their health.

I try to do it [respond to the Health Buddy[®] device] every day. I know it makes a better record and I do write down my blood pressure, heart rate, and peak flow meter. I am going to take that to my doctor next time if he doesn't get a copy of it.

I believe it [the program] has helped me manage my condition a lot better. The questions that are asked of me have helped me.

Over time, the number of correct responses goes up. It's a learning process with the trivia questions. I found the box intimidating, but then it kind of leaves after awhile. When you really feel that there's some positive things happening as a result of this little box, your whole attitude changes.

A few participants offered recommendations for changing the program.

I would like to see the program more interactive where you email in and email out and answer questions and you can go back and forth. (...) We have a whole group of people coming who are 65 or 70 who are used to cell phones and things and they are going to want an interactive system. I would love to see that happen and participate in it. It is better for timing and for the case manager because they don't have to take or make phone calls.

...It's tiring when you're getting the same thing each day so to make it better, look at the frequency of changing the questions.

1.9 Outcomes

1.9.1 Data Used to Monitor Performance Outcomes Performance

- Enrollment was monitored and recruitment activities were planned based on the enrollment data that was available in the Health Buddy[®] Companion, a system that managed information about patient eligibility and enrollment status based on CMS data. It was also used to document interactions with patients enrolled in the Alternate Program and generated intervention reports required by CMS.
- Reports were developed within the Health Buddy[®] Companion system of "Report Manager" to address management needs, telephone and address checks, and sentinel event recruitment efforts. The Report Manager allowed Care Managers to view who was in the program, who was not, and filter the population by various characteristics (e.g., those who died, those who were enrolled with a recent sentinel event).
- Encompass reports were used as the predictive modeling tool and also provided information on other comorbid conditions which may have required management.
- Health Buddy[®] Desktop was used for all details related to the care management of patients using the Health Buddy[®] device including clinical data and data supplied to physicians, usually in the form of trend reports on individual patients.

BMC program staff reviewed their enrollment numbers and non-responder reports on a daily basis. They used the report data to help design the most efficient workflow for each day and week. RBHC managed data from CMS, financial data and clinical quality measures.

Sentinel Event Data—RBHC had previously contracted with Noridian to provide hospitalization and emergency room utilization data on intervention beneficiaries. Care Managers received sentinel event data from Noridian roughly one month after each acute care event occurs. However, the contract with Noridian was not renewed. WVMC and Central Washington Hospital established an agreement in which Central Washington Hospital agreed to notify WVMC staff on a weekly basis of Health Buddy[®] West beneficiaries who had been seen in the ER or admitted to the hospital.

Medicare Claims Data—RBHC reported primarily using the claims data provided by CMS and ARC to have a better understanding of the risk profile of the population and to quantify the characteristics of beneficiaries who benefitted the most from the Health Buddy[®] device and as appropriate, share this information with the medical groups to inform their outreach efforts. RBHC began using claims data provided by CMS to develop a better understanding of how to stratify and risk-adjust their population, and apply that understanding to how they managed the population on an advisory basis to the care management programs. The risk profile influenced how they targeted beneficiaries for engagement by allowing them to quantify the characteristics of beneficiaries who benefitted the most from the program. RBHC contracted with The Analysis Group, a third party consulting organization, to look at differences in cost and utilization by site, differences in the Health Buddy[®] device's impact by disease state, and dose-response effects (e.g., points in the Health Buddy[®] device use cycle that yielded the largest decreases in costs and implications of participants graduating or withdrawing from the program).

1.9.2 Fees and Financial Risk

RBHC received a \$132 per member per month (PMPM) fee, a 3.2% increase over the 2008 fee, and carried sole risk for the program. As the prime contractor, RBHC paid the fees to WVMC and BMC.

1.9.3 Program Participation

Detailed information regarding program participation is included in Chapter 3. About 35% of beneficiaries eligible to participate within each of the three populations participated. When asked about potential reasons why eligible non-participants chose not to participate in the Health Buddy[®] West program, key contributing factors mentioned by the BMC staff include unfamiliarity with the telehealth concept and the fact much of the population in central Oregon lives in a semi-rural population and may not be accustomed to frequent medical intervention. As the BMC Health Buddy[®] West Medical Director stated:

Many pride themselves on coming to the doctor infrequently...and we spend a lot of time trying to dissuade people from this kind of viewpoint. My patients that have been somewhat reticent to engage in this at first may feel that it's something that may be intrusive in their home. They might feel at first that they don't need it and that they aren't that sick. So it does require upfront education (. . .) Even if someone doesn't

want to take medication for hypertension, at least that concept is familiar in our society where you have a problem and take a pill. But Health Buddy® is much less familiar; it's foreign to have a computer sitting in your home that you have to respond to on a daily basis. Like many things, changing heart requires a little bit of effort.

Development of a relationship between participants and Care Managers, timing (e.g., after a sentinel event) and personalization of telephone calls were identified as key factors that facilitated participant engagement in the program. The program experienced success in recruiting eligible participants following a sentinel event (e.g., recent hospital admission or ER visit). At BMC, the Program Lead and Care Manager spent time reviewing a potential participant's medical history prior to calling them in an effort to personalize the recruitment calls. They felt that this personalization was valuable in establishing a connection with potential participants and affected their willingness to enroll in the program. They also observed an increase in recruitment of eligible non-participants when they offered home visits to demonstrate the unit in the participant's home and to ensure that equipment was properly installed.

The standard operating procedure was to contact participants if they did not respond to the device within a seven-day period. Prior to contacting the non-responders, program staff reviewed data and notes to determine when the last session occurred, whether a technical glitch may have occurred, or whether the participant may have gone out of town. For more frequent responders, staff often contacted the participants earlier than seven days in an effort to identify any potentially concerning health issues before they escalated.

The Program Lead and Care Manager attributed more active engagement to greater awareness and more frequent contact generated by program newsletters and electronic messaging on the Health Buddy® device. Using a messaging feature located on the Health Buddy® Desktop, program staff could send personalized messages to a particular patient (e.g., sending birthday wishes, requesting that they call the program staff), or to all participants informing them of upcoming workshops. Staff noted that this feature saved time and paper in that they no longer had to print fliers to advertise upcoming events.

1.10 Implementation Experience, Lessons Learned, and Recommendations

1.10.1 Program Facilitators and Successes

- WVMC felt fortunate to have participated in the development of the program since its inception and to have the flexibility to create a program that fit their facility. As the program evolved, WVMC was involved with updates to the computer applications and dialogue content. The process gave them ownership, promoted a broad picture and better understanding of the program, and facilitated consistency with changes as the program continued to evolve.
- The program promoted greater awareness of the need for care management for beneficiaries with chronic illness and fostered closer relationships between participants and Care Managers. It also allowed participants to be better educated and feel more comfortable with self-management of their disease.

- BMC program staff indicated that program newsletters, workshops and wellness days provided by medical experts enhanced participant enrollment, education, retention and motivation.
- Physician support was cited as a significant aspect of the program's success at BMC. Because patients are often wary of programs like Health Buddy[®], physician feedback can be a significant factor in encouraging patients to begin and continue the program in an effort to improve their overall health.
- The sites felt fortunate to have a supportive working relationship with the CMS project officer and appreciated the continuity over the six year period.

1.10.2 Implementation Challenges

- A three-site demonstration can present significant management and coordination challenges, particularly when complex distinctions exist between the populations and models at each site.
- Many beneficiaries with ischemic heart disease had an intervention (e.g., angioplasty) that led to the self-perception that they were "cured." Given that their health status appeared stable, Care Managers found it challenging to actively engage such beneficiaries.
- Care Managers found the interface issues involving the multiple computer applications required to manage the program cumbersome and inefficient.
- Program staff expressed frustration with the HB3 model used with the Phase II population. Care Managers spent more time troubleshooting problems with the new model than with the prior model, often requiring home visits to correct connection issues. Failure to rectify the issue rendered participants unable to use the device and placed them in the Alternate Program involving telephonic care management, rather than primarily through the Health Buddy[®] device. However, introduction of the cellular modems later in the demonstration enabled them to transition patients out of the Alternate Program and provide them with a Health Buddy[®] device. The transfer of these patients to the active Health Buddy[®] program improved both the monitoring of health care status for those patients and the relationship with the Care Manager.
- Site visit participants noted that the increased complexity of care for older chronically ill patients will continue to be the greatest challenge to providing quality care and financial stability for any facility.
- Hospitalists delayed communication with physicians when patients were admitted to the hospital or seen in the ER, a problem that site visit participants noted as a system-wide challenge, and not specific to the program.

- Site visit participants reported frustration with the time lag in the receipt of claims data and felt that it thwarted the ability to make real-time change and operate in the continuous improvement cycle.

1.10.3 Lessons Learned

- The Health Buddy[®] device provided Care Managers with daily information and a valid reason to contact the patient. Unlike a cold call, it provided value to the participants and to the physicians as well.
- **The Health Buddy[®] Device is a useful care management tool; however, the services provided by the Care Managers are essential to the program's success.** Staff at both clinics reported that the Health Buddy[®] device was a tool that enabled them to monitor and intervene for a larger number of participants than they would otherwise have been able to manage. However, they also pointed out that the value of care management was demonstrated and shown to both improve care and decrease costs. Some felt that the personal relationship between the participant and Care Manager and the services provided by the Care Managers were perhaps most critical to the program's success. As one participant noted, "The Health Buddy[®] unit itself is a great tool, but it doesn't survive without a real person behind it – I think that's the key to it. . ." Consequently, site visit participants felt that there should be recognition and reimbursement for services provided by Care Managers. Personalized care facilitates more actively engaged participants and participant retention.
- **Medicare beneficiaries have a multiplicity of health care needs.** Care Managers recognized early in the demonstration that the targeted conditions that qualified beneficiaries to participate were not necessarily the conditions that provided the greatest day-to-day challenges to the beneficiaries. Diagnoses such as cancer, chronic pain, depression, Parkinson's disease, and fibromyalgia also played a part in morbidity and should be addressed.
- **There is an expensive random component to Medicare FFS expenditures.** Care Managers noted that geriatric beneficiaries with multiple morbidities inevitably decline and that they had ER visits and hospitalizations for reasons that were unrelated to their chronic conditions and not amenable to modification through the Health Buddy[®] West program (e.g., the need to replace a hip joint or a mitral valve). As the demonstration was structured, the key to achieving savings was reducing hospitalizations and ER visits; yet there was an expensive random component.
- **Implement a risk-adjusted view of the population.** RBHC mentioned that in hindsight, they would have liked to have had a risk-adjusted view of the population to guide the sites in their outreach and specific beneficiary-level interventions.
- **Efficiency-focused changes in outreach may greatly facilitate recruitment efforts:** For the Phase II population, WVMC sent contact letters out in waves so that beneficiaries with a PCP within the clinic received letters before beneficiaries with a PCP in external clinics. Beneficiaries within the clinic system were further prioritized

according to a risk assessment. A contract was established with Health Care Partners to initiate telephone contact with beneficiaries after receiving the first letter and schedule beneficiaries for an orientation appointment to enroll in the program. During Phase II, starting from day one, there were clear expectations and policies and procedures in place regarding beneficiary recruitment by Health Care Partners. Starting from ground zero with Health Care Partners versus having them come in to assist with recruitment after several months facilitated recruitment. RBHC also produced a new promotional DVD that was included with the recruitment packets and shown at the enrollment orientation sessions. The Care Managers felt that the DVD was effective in encouraging beneficiary enrollment. Many beneficiaries were ready to sign up upon watching the five minute DVD.

- **Patients rely on the opinions and values of their physicians; helping physicians develop a full understanding of the Health Buddy[®] program can improve patient involvement.** Once physicians were educated on the program and learned the “value added” potential for their clinical workflow, they became active partners in the program. However, due to the lack of physician involvement in identifying patients for the program, the program still faced the challenge of supporting better physician inclusion in decision making and increased physician support for enrollment and engagement.
- **Make the initial introduction to the program more physician-oriented and allow the physicians more of a role in determining who should be included using a pre-defined set of criteria.** Physicians would have liked to refer more of their patients, but were limited by the small number of patients on their eligibility list.
- **More one-on-one enrollment meetings in the clinic and home visits may be necessary for high-risk patients.**
- **Addressing pressing patient health issues early in the enrollment process helped to convince beneficiaries to engage in the program and improve retention.**
- **Trend reports of Health Buddy[®] results were delivered to physicians to coincide with office visits at WVMC.** This resulted in enhanced use by the physicians (with examples such as adjustments to patients’ medications and increased efficiency of office visit time). The closer working relationship with the physicians also led to office visit scheduling access for the Care Managers.

1.10.4 Recommendations

- **Monitor staffing levels.** Track staffing levels to ensure that as caseloads increase, staff is able to find a balance between enrollment and care management activities.
- **Engage physicians early.** Staff at both clinics expressed that physician support is critical to patient buy-in. If possible, Care Managers should try to obtain a referral or letter directly from a physician to facilitate beneficiary recruitment, particularly among beneficiaries that are newly diagnosed.

- **Implement a physician referral model.** Many physicians recognized the potential value of the Health Buddy[®] West program and could identify beneficiaries whom they felt could really benefit from it. Physicians should have input on beneficiary selection for the program.
- **Embed Care Managers within physician practices to enhance the efficiency of participant monitoring and communication with physicians.** Not all Care Managers were embedded within the physician practices which sometimes resulted in delays in the exchange of information. Co-location allows Care Managers to more easily learn about established physician-patient relationships, what kinds of information the physicians want from the Care Managers, when the physicians want to be contacted, and how best to communicate with them. Care Managers felt that co-location with physicians was a win-win situation for everyone – the participants and physicians were well-prepared for the appointment, “the best care” was provided, and the care was cost-effective. Co-location may also improve beneficiary enrollment and physician support for the program.
- **Use a minimal number of computer applications to document, track, and store demographic information.** Care Managers found the multiple computer applications used to manage the program inefficient and burdensome.
- **Target beneficiaries who will be sustainably high-cost and have manageable chronic conditions.** RBHC viewed telehealth as fundamental to efforts to “cost-effectively provide continuous and frequent support in a way that leverages scarce nursing resources and can keep beneficiaries healthier and thus reduce their demand for care.”
- **A sufficient ramp-up period should be allocated to enable sites to hire and train staff, develop protocols for recruitment and data collection for outcomes measurement.**
- **Develop a dynamic scoring system to score patients during or immediately following a hospitalization as a means of indicating the increased severity of a patient; reassess a patient’s qualification for eligibility as the need arises.** Physicians noted that CMS claims data were outdated, non-specific, and did not reflect the severity of the underlying condition.

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.

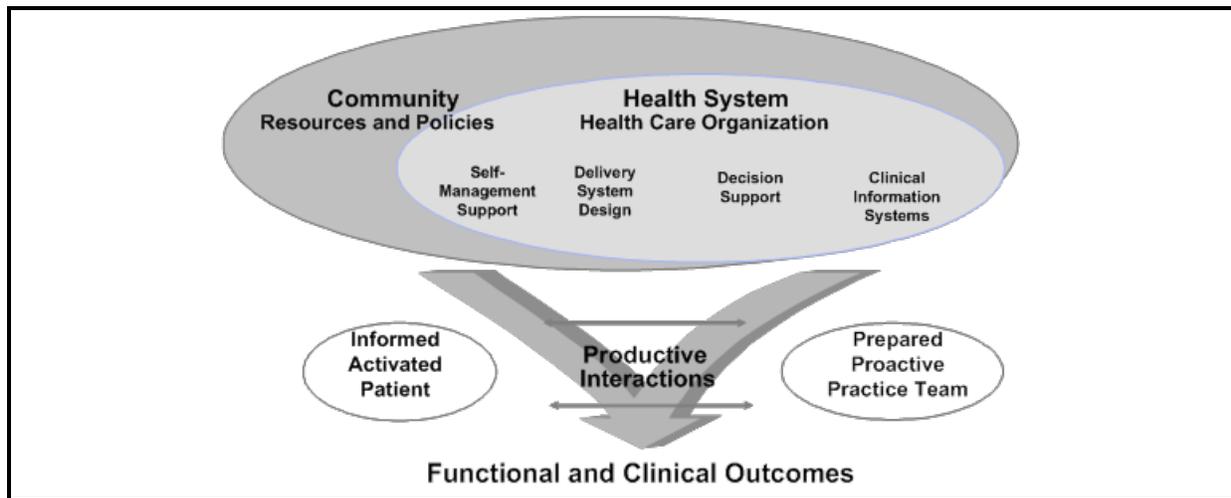
2.1.2 Emerging Approaches to Chronic Care

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).¹ 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:

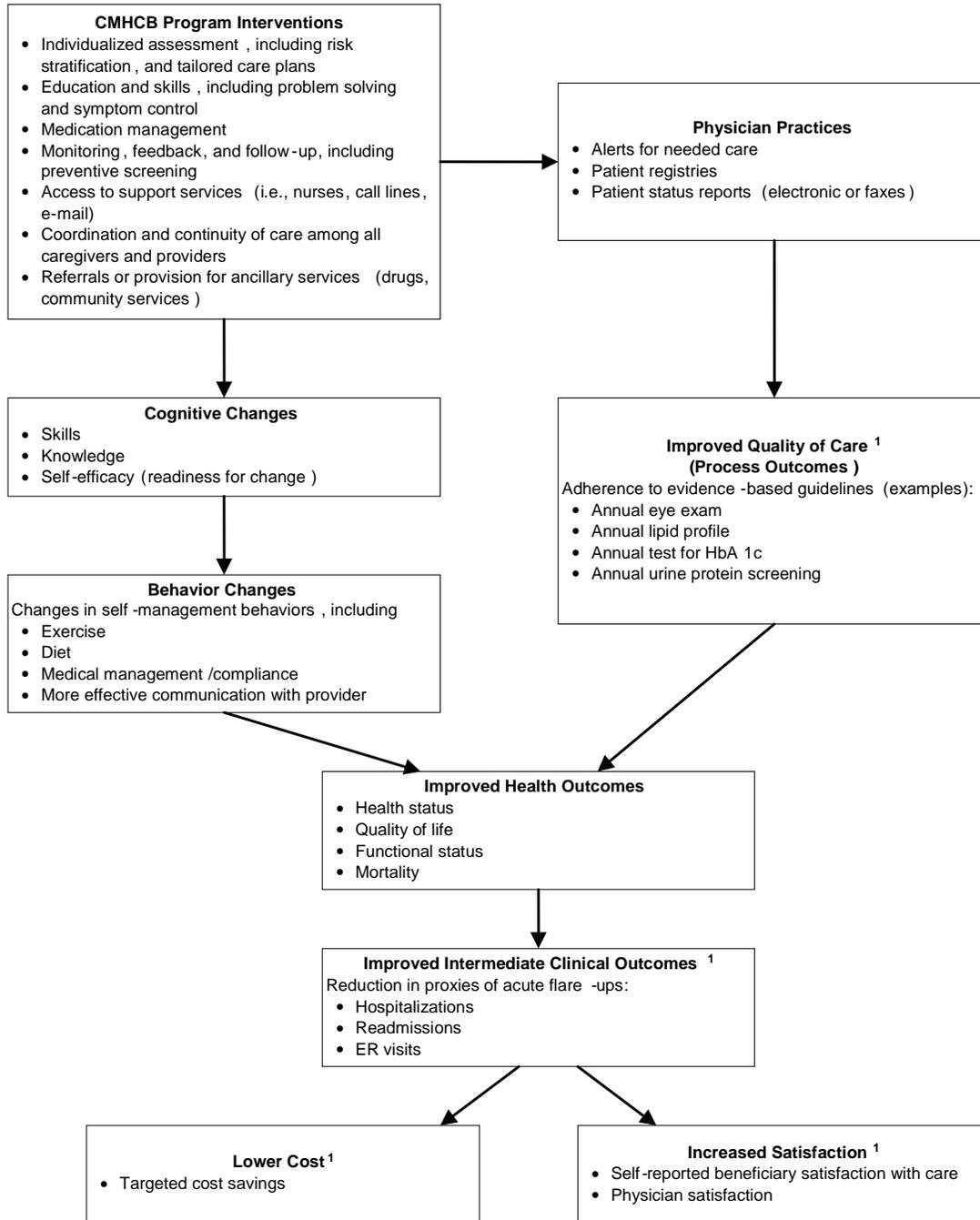
- *Individualized assessment.* Several CMOs use proprietary algorithms to calculate a risk score or risk scores, while others depend on judgment of clinical staff. The scores are used to customize interventions to the participants' needs.
- *Education and skills.* A key step in improving self-management is educating beneficiaries and their families about their illnesses, how to react to symptoms, and

¹ 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[®] West Program 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[®] West Program Demonstration implementation experience was 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 able to implement its Phase II Health Buddy[®] West Program?				
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 [®] West Program?	Yes	Yes	No	No
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 [®] West Program engage physicians and physician practices in their programs?	Yes	No	No	No
REACH: How well did the Phase II Health Buddy[®] West Program 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[®] West Program able to improve clinical quality and health outcomes, and achieve targeted cost savings?			
<i>Quality of care, health outcomes, and utilization</i>			
1. Did the Phase II Health Buddy [®] West Program 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 [®] West Program improve intermediate health outcomes by reducing acute hospitalizations, readmissions, and ER utilization?	No	No	Yes
3. Did the Phase II Health Buddy [®] West Program improve health outcomes by decreasing mortality?	No	No	Yes
<i>Financial outcomes</i>			
1. How variable are per beneficiary per month (PBPM) costs in the intervention and comparison populations?	No	No	Yes
2. What was the minimally detectable savings rate given the variability in beneficiary PBPM costs?	No	No	Yes
3. For the three Phase II cohorts, what were the Medicare PBPM costs in the base year compared with the demonstration period for the intervention and the comparison cohorts?	No	No	Yes
4. 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
5. How did Medicare savings in the three Phase II cohorts compare with the fees that were paid out? Did the Phase II Health Buddy [®] West Program Demonstration meet budget neutrality using RTI's methodology?	No	No	Yes
6. How balanced were the intervention and comparison group samples on patient characteristics prior to the demonstration's Phase II start date? How important were any differences to the estimate of savings?	No	No	Yes
7. Did users of the Health Buddy [®] device show cost savings when compared with a matched group of non-users?	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.

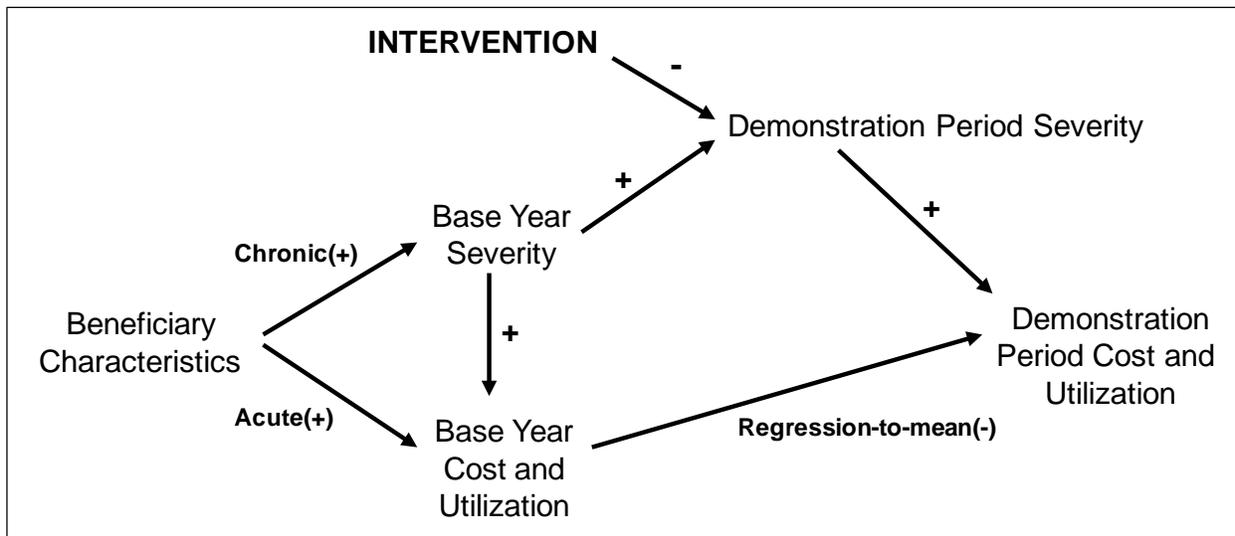
This model uses three sets of variables in analysis of covariance (ANCOVA) format to capture differences between intervention and comparison beneficiaries. The β_1 coefficient provides a test of the difference between the intervention group and comparison group in the base period for a particular outcome 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[®] West Program 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[®] West Program 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[®] West Program 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[®] West Program 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[®] West Program 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[®] West Program 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 used the start date of Phase II (April 1, 2009) to conduct an EDB extract to obtain demographic characteristics for the Phase I Original and Refresh populations and the Phase II population. ARC did their final eligibility determination for the Phase II population on April 2, 2009.
- *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[®] West Program 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[®] West Program 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[®] West Program 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® West Program 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® West Program 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® West Program 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® West Program CMHCB Demonstration analysis of performance

Intervention period start date	Intervention period final end date	Intervention period months	Baseline period start date	Baseline period end date
4/1/09	1/31/12	34	4/1/08	3/31/09

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 all three populations, age, gender, race, and Medicare status (aged-in versus disabled) were obtained from the EDB and determined as of the Phase II start date (April 1, 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[®] West Program was active in the demonstration. The numerator is the number of days the beneficiary is eligible during that time period. All three populations participated in the Phase II demonstration for 34 months, so the number of days in the denominator for each population beneficiary in the Phase II Demonstration is 1,036 (Phase II Health Buddy[®] West Program end date minus Phase II Health Buddy[®] West Program 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 1,036, or 0.405.

- 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[®] West Program 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.

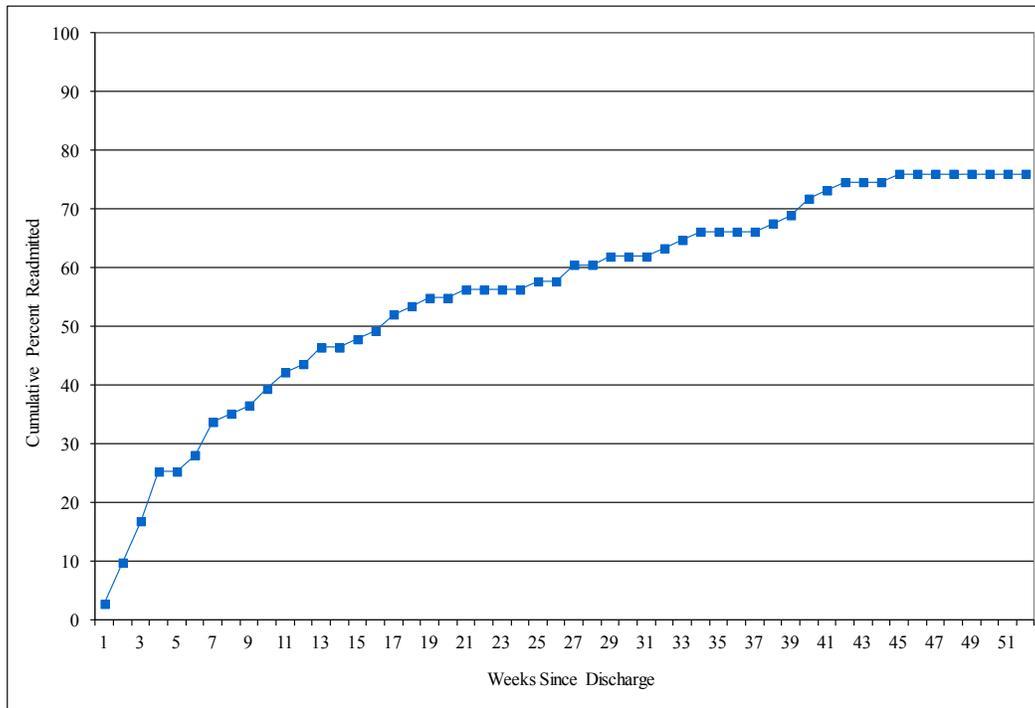
Only claims that occurred during periods of eligibility were included in the utilization measures. For both the demonstration and baseline periods, claims were included if services were started during days that the beneficiary met the Phase II Health Buddy[®] West Program Demonstration eligibility criteria, 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 44% of subsequent admissions in our analyses².

² 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.

Figure 2-4
Percent with readmission for any diagnosis during the Phase II Health Buddy® West Program CMHCB Demonstration: Phase I Original baseline comparison 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 readmission rates examined admissions during the periods of months 7 through 18 and included readmissions through month 21 and admissions during months 20 through 31 and included readmissions through month 34. A readmission was defined as an admission up to 90 days after an index hospitalization discharge date. We 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[®] West Program Demonstration period, total Medicare payments were summarized for the 34-month Phase II intervention period.

- 7) ***Guideline Concordant Care.*** We define quality of care as adherence to evidence-based guideline-concordant care. The selected measures have been extensively tested and are widely accepted as clinically important measures and appropriate for use in pay-for-performance initiatives. We restrict the selection of measures to those that do not require the use of CPT II codes.

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:

- Diabetes beneficiaries:
 - 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[®] West Program 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[®] West Program 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[®] West Program 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[®] West Program 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[®] West Program 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[®] West Program Demonstration. The first step was to examine the first reason for ineligibility during the intervention for beneficiaries that were eligible at the start of the Phase II intervention period. We then evaluated baseline characteristics during the baseline period for all three Phase II populations for both the intervention and comparison populations. Finally, we constructed propensity score weights to account for baseline differences between the intervention and comparison groups.

2.3.1 Initial Reason for Ineligibility

Table 2-4 provides the first reason a beneficiary became ineligible and, using the chi-square test, determines if these distributions are different between the intervention and comparison groups. In all cohorts, death was the leading reason for ineligibility and more than 10% of the Phase I cohorts elected hospice. In the Phase I Original population, the intervention group had a slightly higher rate of ineligibility due to beneficiaries joining a managed care plan. There were no statistically significant group differences for the Phase I Refresh population. The Phase II population comparison beneficiaries had a slightly higher mortality rate than the intervention group (10.5% versus 7.9%). The overall attrition rate declined over time, ranging from 48% of the Phase I Original cohort to 25% of the Phase II population.

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

Reasons for ineligibility	I	C	I %	C %	I-C	Likelihood ratio X ²	p-value
<u>Phase I Original</u>							
Number of beneficiaries eligible on 4/1/09	426	405	100.0	100.0	N/A	N/A	N/A
Died	95	108	22.3	26.7	-4.4	2.14	0.14
ESRD	7	4	1.6	1.0	0.7	0.69	0.41
Joined MA Plan	25	11	5.9	2.7	3.2	5.12	0.02
Elected Hospice	73	61	17.1	15.1	2.1	0.66	0.42
Medicare Secondary Payer	0	0	0.0	0.0	N/A	N/A	N/A
Loss of Part A or Part B	1	0	0.2	0.0	0.2	1.34	0.25
Moved Out of Service Area	3	9	0.7	2.2	-1.5	3.50	0.06
Number of beneficiaries eligible on 1/31/12	222	212	52.1	52.3	-0.2	N/A	N/A
<u>Phase I Refresh</u>							
Number of beneficiaries eligible on 4/1/09	741	716	100.0	100.0	N/A	N/A	N/A
Died	128	146	17.3	20.4	-3.1	2.32	0.13
ESRD	4	9	0.5	1.3	-0.7	2.17	0.14
Joined MA Plan	36	22	4.9	3.1	1.8	3.07	0.08
Elected Hospice	94	87	12.7	12.2	0.5	0.10	0.76
Medicare Secondary Payer	1	2	0.1	0.3	-0.1	0.38	0.54
Loss of Part A or Part B	0	2	0.0	0.3	-0.3	2.84	0.09
Moved Out of Service Area	17	8	2.3	1.1	1.2	3.06	0.08
Number of beneficiaries eligible on 1/31/12	461	440	62.2	61.5	0.8	N/A	N/A
<u>Phase II population</u>							
Number of beneficiaries eligible on 4/1/09	2,074	2,071	100.0	100.0	N/A	N/A	N/A
Died	164	217	7.9	10.5	-2.6	8.23	0.00
ESRD	8	24	0.4	1.2	-0.8	8.46	0.00
Joined MA Plan	113	71	5.4	3.4	2.0	10.05	0.00
Elected Hospice	155	146	7.5	7.0	0.4	0.28	0.60
Medicare Secondary Payer	5	7	0.2	0.3	-0.1	0.34	0.56
Loss of Part A or Part B	1	1	0.0	0.0	0.0	0.00	1.00
Moved Out of Service Area	49	48	2.4	2.3	0.0	0.01	0.92
Number of beneficiaries eligible on 1/31/12	1,579	1,557	76.1	75.2	1.0	N/A	N/A

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

MA = Medicare Advantage.

N/A means not applicable

Data Sources: RTI analysis of 2008–2012 Medicare enrollment, eligibility, claims and encounter data.

Program: lost_elig2a; lost_elig2b

2.3.2 Propensity Score Methodology

Propensity Score Estimation. While the Health Buddy[®] West Program Demonstration intervention and comparison group areas were drawn from similar geographic areas and matched by size, 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 intervention group. Propensity scores were estimated by logistic regression, regressing group status (1=intervention 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[®] West Program 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[®] West Program 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 intervention group status, two additional propensity models were estimated based on users of the Health Buddy[®] West Program Demonstration device. The first model examined the usage decision by contrasting device users with nonusers aggregated across all three intervention cohorts. The second model compared users to the comparison group to derive weights for outcome analyses restricted to users. These models were based on the same covariates described above.

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

When groups are well-balanced in terms of beneficiary characteristics, individual characteristics should have little influence on propensity scores. Propensity model results for each cohort are examined in three different ways in **Table 2-5**. First, the table shows the mean propensity score for each group. The means should be close to 0.50 (indicating a 50-50 chance of being in the intervention group) if the groups are balanced. Second, the table reports the c-statistic for each cohort model. This statistic measures the degree to which the model correctly distinguishes between the two groups. The lowest possible value is 0.50, which indicates that no differentiation was achieved. Finally, the table lists any characteristics (out of 11 predictors) that had statistically significant effects ($p < 0.001$) in the model.

Table 2-5
Summary of propensity score analyses by cohort;
Phase II Health Buddy® West CMHCB Demonstration

	Phase I Original		Phase I Refresh		Phase II population	
	Inter.	Comp.	Inter.	Comp.	Inter.	Comp.
Mean propensity score	.530	.497	.521	.504	.506	.495
Model c-statistic	.604		.577		.563	
Significant predictors of group status	• (None)		• Charlson Comorbidity (+) • HCC risk score (-)		• HCC risk score (-)	

NOTES: CMHCB = Care Management for High Cost Beneficiaries; HCC = Hierarchical Condition Category.

In each cohort, the mean propensity probability was close to 0.50 in both the intervention and comparison groups. The c-statistics were all below 0.61 indicating the models did a little better than chance in differentiating between the groups. Finally, the only characteristic associated with group status in more than one cohort was a small effect for HCC risk score. The negative risk score effect was largely offset by a positive Charlson Comorbidity effect in the Phase I Refresh group.

Health Buddy® Device Users. In the combined cohorts, 28.5% of the beneficiaries reported using the Health Buddy® device for at least one quarter during the Phase II demonstration period. Usage rates were 22% in the Phase I Original group, 24% in the Phase I Refresh Population and 31% in the Phase II population. The pooled propensity model for the intervention cohorts provides information about characteristics that are associated with a beneficiary's decision about whether to use the device. The results indicated that users were less likely be 85 years or older, from one of the Phase I cohorts, and have higher Charlson Comorbidity scores but lower HCC risk scores. These effects were comparatively small (c-statistic = 0.585) and do not provide a clear indication that either sicker or healthier beneficiaries were more likely to make use of the Health Buddy® device.

2.5 Comparison of Beneficiary Characteristics

Detailed characteristics for beneficiaries at baseline are shown in *Tables 2-6a through 2-6c* 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. The right panel shows the results after adjustment by propensity weights.

Table 2-6a shows the data for the Phase I Original beneficiaries. Of the 28 characteristics examined, there were five statistically significant differences. There were proportionally more women and disabled beneficiaries in the comparison group. After weighting by both eligibility fraction and propensity score (right side panel in *Table 2-6a*), all group differences were eliminated.

In the Phase I Refresh population (*Table 2-6b*), there was only one significant unadjusted group difference to begin with. A minor difference in HCC risk scores was removed by propensity score weighting. For the Phase II population beneficiaries (*Table 2-6c*), there were a number of initial differences in hospital and ED utilization rates whereby they were consistently higher in the comparison group than in the intervention group, although these were attributable in part to the larger samples in this cohort. Propensity weighting greatly reduced the magnitude of these differences although some remained statistically significant.

The general pattern was that in each cohort the intervention and comparison groups were generally well-matched during the year prior to the start of Phase II and that nearly all observed differences were removed by propensity weighting. Propensity weights achieve this effect by giving greater influence to comparison beneficiaries who are most similar to those in the intervention group. The process is illustrated by the “butterfly” graph in *Figure 2-5* for selected characteristics for the Phase II population cohort. The bars on the left side of the graph depict the intervention group means. The bars to the right show the comparison group means before and after propensity weighting. For each characteristic, weighting draws the comparison mean closer to the intervention group mean. Other than a reduction in the percent of comparison group women, the weighting produced only minor shifts in this cohort. The shifts are especially pronounced for the proportions of women and disabled 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 all-cause hospitalization and ER visit rates for the Phase II population which were no longer statistically different after propensity adjustment (*Table 2-6c*). The propensity weights were used in subsequent multivariate outcome analyses to reduce potential bias when estimating the effects of the Health Buddy[®] West Program Demonstration intervention.

Table 2-6a

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

Characteristics	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			
	I	C	I-C	p-value ¹	I	C	I-C	p-value ¹	I	C	I-C	p-value ¹
Number of eligibles	426	405	N/A	N/A	402	382	N/A	N/A	402	382	N/A	N/A
Number of FTEs	424	401	N/A	N/A	400	378	N/A	N/A	400	378	N/A	N/A
Age	77.8	77.7	0.1	N/S	77.7	77.5	0.2	N/S	77.7	78.0	-0.2	N/S
Age < 65	5.0	9.0	-4.1	*	5.0	9.3	-4.3	*	5.0	5.0	0.0	N/S
Age 65-74	25.9	26.5	-0.6	N/S	26.2	27.3	-1.1	N/S	26.2	26.3	-0.1	N/S
Age 75-84	50.5	39.1	11.5	**	50.8	38.5	12.2	**	50.8	50.7	0.1	N/S
Age 85+ years	18.6	25.4	-6.8	*	18.0	24.9	-6.8	*	18.0	18.0	0.0	N/S
Female	46.8	56.7	-9.9	**	47.7	57.5	-9.9	**	47.7	47.5	0.2	N/S
White	96.9	96.3	0.7	N/S	96.8	96.0	0.7	N/S	96.8	96.4	0.4	N/S
Disabled	5.4	10.0	-4.6	*	5.5	10.4	-4.9	*	5.5	5.5	0.0	N/S
Medicaid	20.1	24.7	-4.6	N/S	18.8	24.1	-5.3	N/S	18.8	19.4	-0.5	N/S
Institutionalized	2.1	2.8	-0.6	N/S	2.0	2.7	-0.6	N/S	2.0	1.9	0.1	N/S
Average HCC score	2.0	2.1	-0.1	N/S	1.9	2.0	-0.1	N/S	1.9	1.9	0.0	N/S
Average Charlson Index	3.7	3.7	0.0	N/S	3.6	3.6	0.1	N/S	3.6	3.6	0.0	N/S
Rate of all-cause hospitalizations	595	696	-102	N/S	565	635	-70	N/S	565	622	-56	N/S
Rate of ACSC hospitalizations	307	357	-50	N/S	273	320	-48	N/S	273	309	-36	N/S
Rate of all-cause emergency room visits	1,211	1,403	-192	N/S	1,143	1,302	-159	N/S	1,143	1,208	-65	N/S
Rate of ACSC emergency room visits	505	517	-12	N/S	450	490	-39	N/S	450	462	-12	N/S
Rate of all-cause 90-day readmissions	553	653	-99	N/S	560	534	25	N/S	560	493	67	N/S
Rate of ACSC 90-day readmissions	211	354	-143	N/S	211	291	-80	N/S	211	236	-25	N/S
Average PBPM Medicare Expenditures												
Total	1,131	1,162	-31	N/S	1,077	1,066	11	N/S	1,077	1,071	6	N/S
Long-term care	0	9	-9	N/S	0	0	0	N/A	0	0	0	N/A
Rehabilitation	28	10	17	N/S	29	11	19	N/S	29	11	18	N/S
Psychiatric	2	0	2	N/S	2	0	2	N/S	2	0	2	N/S
Inpatient	450	467	-17	N/S	430	407	23	N/S	430	397	33	N/S
Home Health	49	69	-20	N/S	46	66	-20	N/S	46	60	-14	N/S
DME	73	58	16	N/S	70	56	14	N/S	70	55	15	N/S
Physician	262	224	38	N/S	259	218	41	*	259	219	40	N/S
Skilled Nursing Facility	102	143	-41	N/S	81	136	-55	N/S	81	155	-74	N/S
Hospital Outpatient	166	179	-13	N/S	159	169	-10	N/S	159	171	-11	N/S

Table 2-6b

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

Characteristics	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			
	I	C	I-C	p-value ¹	I	C	I-C	p-value ¹	I	C	I-C	p-value ¹
Number of eligibles	741	716	N/A	N/A	726	689	N/A	N/A	726	689	N/A	N/A
Number of FTEs	737	712	N/A	N/A	722	685	N/A	N/A	722	685	N/A	N/A
Age	77.7	77.4	0.3	N/S	77.6	77.2	0.5	N/S	77.6	77.6	0.1	N/S
Age < 65	6.9	8.0	-1.1	N/S	6.9	8.1	-1.2	N/S	6.9	6.8	0.1	N/S
Age 65-74	29.0	28.5	0.5	N/S	29.1	28.9	0.1	N/S	29.1	29.7	-0.6	N/S
Age 75-84	40.7	41.3	-0.6	N/S	40.7	41.6	-0.9	N/S	40.7	40.6	0.1	N/S
Age 85+ years	23.4	22.2	1.2	N/S	23.3	21.4	2.0	N/S	23.3	23.0	0.4	N/S
Female	45.9	47.9	-2.0	N/S	45.9	47.6	-1.7	N/S	45.9	45.6	0.3	N/S
White	96.6	96.4	0.2	N/S	96.5	96.5	0.0	N/S	96.5	96.5	0.0	N/S
Disabled	7.0	8.7	-1.6	N/S	7.0	8.9	-1.8	N/S	7.0	7.1	-0.1	N/S
Medicaid	19.3	21.8	-2.5	N/S	18.7	21.8	-3.1	N/S	18.7	18.4	0.3	N/S
Institutionalized	2.6	2.4	0.2	N/S	2.5	2.4	0.1	N/S	2.5	2.5	0.0	N/S
Average HCC score	1.6	1.8	-0.1	*	1.6	1.7	-0.1	*	1.6	1.7	0.0	N/S
Average Charlson Index	3.1	3.0	0.1	N/S	3.1	2.9	0.2	N/S	3.1	3.1	0.0	N/S
Rate of all-cause hospitalizations	472	530	-58	N/S	450	502	-52	N/S	450	479	-29	N/S
Rate of ACSC hospitalizations	241	259	-17	N/S	228	241	-12	N/S	228	228	0	N/S
Rate of all-cause emergency room visits	1,029	1,197	-168	N/S	998	1152	-154	N/S	998	1065	-67	N/S
Rate of ACSC emergency room visits	391	496	-105	N/S	375	474	-99	N/S	375	425	-49	N/S
Rate of all-cause 90-day readmissions	484	534	-50	N/S	441	506	-65	N/S	441	467	-27	N/S
Rate of ACSC 90-day readmissions	198	199	0	N/S	176	203	-27	N/S	176	199	-22	N/S
Average PBPM Medicare Expenditures												
Total	886	983	-97	N/S	868	941	-74	N/S	868	891	-24	N/S
Long-term care	0	0	0	N/A	0	0	0	N/A	0	0	0	N/A
Rehabilitation	16	19	-4	N/S	16	18	-2	N/S	16	15	1	N/S
Psychiatric	1	0	0	N/S	1	0	0	N/S	1	0	0	N/S
Inpatient	331	402	-71	N/S	321	385	-63	N/S	321	353	-32	N/S
Home Health	33	43	-10	N/S	31	37	-6	N/S	31	34	-3	N/S
DME	45	45	0	N/S	44	42	2	N/S	44	41	4	*
Physician	200	202	-2	N/S	198	198	0	N/S	198	196	2	N/S
Skilled Nursing Facility	89	89	0	N/S	84	80	4	N/S	84	72	13	N/S
Hospital Outpatient	171	174	-4	N/S	170	173	-3	N/S	170	172	-2	N/S

Table 2-6c

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

Characteristics	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			
	I	C	I-C	p-value ¹	I	C	I-C	p-value ¹	I	C	I-C	p-value ¹
Number of eligibles	2,074	2,071	N/A	N/A	2,025	2,024	N/A	N/A	2,025	2,024	N/A	N/A
Number of FTEs	2,070	2,064	N/A	N/A	2,021	2,017	N/A	N/A	2,021	2,017	N/A	N/A
Age	75.2	75.3	-0.1	N/S	75.2	75.2	0.0	N/S	75.2	75.1	0.1	N/S
Age < 65	7.1	8.3	-1.2	N/S	7.0	8.3	-1.3	N/S	7.0	7.1	-0.1	N/S
Age 65-74	41.3	38.5	2.8	N/S	41.5	38.9	2.6	N/S	41.5	41.4	0.1	N/S
Age 75-84	36.8	37.6	-0.8	N/S	36.9	37.5	-0.6	N/S	36.9	37.1	-0.2	N/S
Age 85+ years	14.9	15.7	-0.8	N/S	14.7	15.4	-0.7	N/S	14.7	14.5	0.2	N/S
Female	43.0	47.6	-4.6	**	42.9	47.2	-4.3	**	42.9	43.2	-0.2	N/S
White	97.0	97.1	-0.1	N/S	97.1	97.1	-0.1	N/S	97.1	97.1	0.0	N/S
Disabled	7.3	8.8	-1.6	N/S	7.2	8.9	-1.7	N/S	7.2	7.3	-0.1	N/S
Medicaid	13.5	15.0	-1.5	N/S	13.5	14.8	-1.3	N/S	13.5	13.9	-0.4	N/S
Institutionalized	0.7	1.1	-0.4	N/S	0.7	1.1	-0.3	N/S	0.7	0.8	-0.1	N/S
Average HCC score	1.3	1.4	-0.1	**	1.3	1.4	-0.1	**	1.3	1.3	0.0	N/S
Average Charlson Index	2.3	2.4	-0.1	N/S	2.2	2.3	-0.1	N/S	2.2	2.2	0.0	N/S
Rate of all-cause hospitalizations	390	459	-69	**	376	436	-60	*	376	424	-48	N/S
Rate of ACSC hospitalizations	133	188	-55	**	124	172	-48	**	124	156	-32	*
Rate of all-cause emergency room visits	776	904	-128	*	748	872	-124	*	748	819	-71	N/S
Rate of ACSC emergency room visits	240	314	-75	**	228	296	-68	**	228	274	-46	*
Rate of all-cause 90-day readmissions	294	433	-139	**	274	390	-116	*	274	379	-104	*
Rate of ACSC 90-day readmissions	111	268	-158	**	93	245	-151	**	93	265	-172	**
Average PBPM Medicare Expenditures												
Total	839	828	11	N/S	814	805	9	N/S	814	822	-8	N/S
Long-term care	0	1	-1	N/S	0	1	-1	N/S	0	0	0	N/S
Rehabilitation	19	16	3	N/S	17	16	1	N/S	17	18	-1	N/S
Psychiatric	0	0	0	N/S	0	0	0	N/S	0	0	0	N/S
Inpatient	339	365	-26	N/S	328	349	-21	N/S	328	361	-34	N/S
Home Health	27	26	1	N/S	23	25	-1	N/S	23	23	0	N/S
DME	31	30	1	N/S	30	29	1	N/S	30	27	3	N/S
Physician	213	189	24	**	210	186	23	**	210	186	23	**
Skilled Nursing Facility	49	61	-12	N/S	48	61	-14	N/S	48	64	-17	N/S
Hospital Outpatient	161	141	21	*	158	138	20	*	158	141	18	N/S

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.

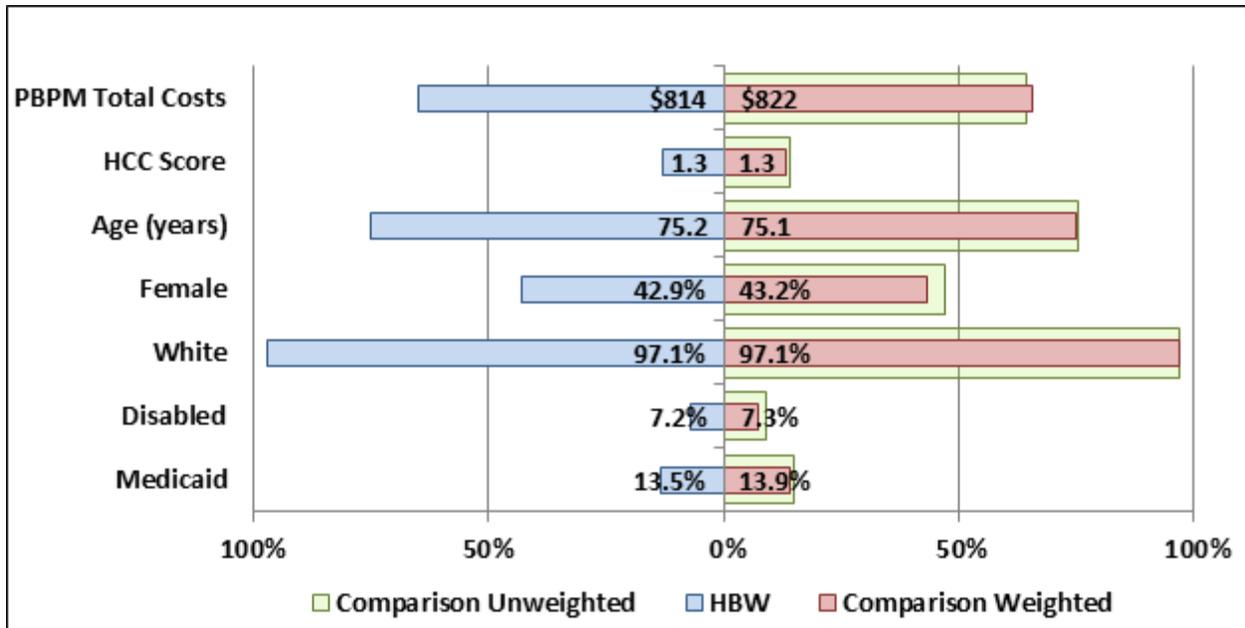
N/A means not applicable; N/S means not statistically significant

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

Data Sources: RTI analysis of 2008-2012 Medicare enrollment, eligibility, claims and encounter data.

SOURCE: table3-1.xls, table3-1c.xls, table3-1final.xls

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



NOTES: HBW = Health Buddy® West Program Demonstration.

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CHAPTER 3

PARTICIPATION RATES IN THE PHASE II HEALTH BUDDY[®] WEST PROGRAM 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[®] West Program 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[®] West Program 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[®] West Program engage their intended audiences? Specific research questions include the following:

- How many individuals did the Health Buddy[®] West Program 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[®] West Program 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 follows 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 October 2009 site visit (six months into the outreach period), RBHC staff reported that WVMC had approximately 575 beneficiaries enrolled in the program. Roughly 35% of the Phase I beneficiaries were enrolled, while of the approximate 1,250 Phase II population, nearly 300 had agreed to participate and about 400 still needed to be contacted (24% enrollment rate). At BMC, 69 of the Phase I population continued as participants (19% of the eligible pool) and they had roughly 136 Phase II population beneficiaries participating out of a pool of 756 eligible beneficiaries for an 18% participation rate (Lenfestey and McCall, 2011). In this report, we examine 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[®] West Program and its beneficiaries with the Health Buddy[®] device. The main intervention for the Health Buddy[®] West Program is the Health Buddy[®] health monitoring device, which collects qualitative

and quantitative survey information from beneficiaries on a daily basis. The Health Buddy[®] West Program also offers an alternate program for beneficiaries who are unable or unwilling to use the Health Buddy[®] device. Furthermore, this program involves 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 ask participants who do not use the Health Buddy[®] device similar questions to those programmed into the device. However, these responses are 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 examine the number of telephonic contacts between Health Buddy[®] West Program staff and their participants with the Health Buddy[®] device. For each participating beneficiary, the Health Buddy[®] West Program 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[®] West Program. 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[®] West Program) and the percentage of beneficiaries participating for more than 75% of their eligible months.³ These latter two sets of numbers provided an estimate of the number of beneficiaries with whom the Health Buddy[®] West Program 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

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

³ 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.

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 start of the Phase II demonstration.

- 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 defined as follows:

- baseline HCC score medium and high, two dichotomous variables set at 1 if the prospective HCC score was from 0.82 to 2.05 (medium) and greater than 2.05 (high); HCC score less than 0.82 is the reference group for the Phase I Original population. For the Phase I Refresh population, a score from 0.89 to 1.81 was defined as medium and high was greater than 1.81; and HCC score less than 0.89 was the reference group. A medium HCC score was defined as from 0.78 to 1.43 for the Phase II population, with high scores identified as those greater than 1.43 and the reference group were beneficiaries with scores less than 0.78.
- baseline Charlson score medium and high, two dichotomous variables set at 1 if the Charlson index score was 3 to 4 (medium) and 5 or greater than (high); Charlson score of less than 3 is the reference group for the Phase I Original population. For the

Phase I Refresh population, a score from 2 to 3 was defined as medium and high was greater than 3; and HCC score less than 2 was the reference group. A medium Charlson score was defined as from 1 to 2 for the Phase II population, with high scores identified as those greater than 2 and the reference group were beneficiaries with scores less than 1.

- 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® West Program Demonstration for the Phase I Original population was greater than or equal to \$284 and less than \$970 (medium) and \$970 or greater (high); PBPM cost less than \$284 was the reference group. For the Phase I Refresh population, baseline PBPM costs greater than or equal to \$199 and less than \$673 were assigned to the medium group and \$673 or greater to the high category; PBPM cost less than \$199 was the reference group. Baseline PBPM costs greater than or equal to \$178 and less than \$627 were assigned to the medium group and \$627 or greater to the high category; PBPM cost less than \$178 was 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® West Program 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 34 months for the Phase I Original and Refresh populations and 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® West Program 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® West Program, 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 Care Managers 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 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 hospitalization measures set at 1:

- if the beneficiary had one hospitalization;
- if the beneficiary had more than one hospitalization.

Beneficiaries with no hospitalizations during the demonstration period were in the reference group. We included these two additional demonstration period intervention variables because Health Buddy[®] West 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[®] West Program 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. The number of months included in this analysis is 34 months for all three populations.

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[®] West Program Demonstration program had a total of 34 months (or 1,036 days) of possible enrollment. If he/she died after 90 days, their FTE value would be 90/1,036 or 0.087 FTEs. If someone were eligible for all 34 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[®] West Program 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 0.80 for the Phase II intervention period (months 1-34) and 0.79 for the comparison group. The FTE estimate illustrates the effect of attrition over time of the original beneficiaries due primarily to death. Beneficiaries also became ineligible for participation in Phase II if they joined a Medicare Advantage 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 Phase II are removed from the intervention and comparison groups for the remainder of the demonstration. In Phase I, beneficiaries who lost demonstration eligibility but then regained eligibility could rejoin the program. Just over one-half of intervention and comparison beneficiaries were eligible for the entire Phase II demonstration period. And, the participant and non-participant groups had similar rates of beneficiaries being fully eligible for the entire intervention period – about 55%.

Table 3-1 also displays eligibility data for the Phase I Refresh population. The ratio of total number of beneficiaries to FTEs was about 0.84 for the intervention and comparison populations, indicating a 16% 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 (67%) than nonparticipants (62%) or the comparison group (64%).

The Phase II population is five times larger than the size of the Phase I Original population and nearly three times larger than the Phase I Refresh population. The ratio of total number of beneficiaries to FTEs was 0.90 for both the intervention and comparison groups, a lower attrition rate than the Phase I populations. The percentage of intervention and comparison beneficiaries that were fully eligible for the full Phase II demonstration period are similar at 78% but is higher among participants (82%) than nonparticipants (76%).

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

Characteristics	Phase I Original Months 1-34	Phase I Refresh Months 1-34	Phase II population Months 1-34
Intervention group			
Number eligible ¹	402	726	2,025
Full time equivalent ²	321	610	1,824
Number fully eligible ³	222	461	1,579
<i>Participants</i>			
Number eligible	142	260	720
Full time equivalent	118	225	673
Number fully eligible	79	173	593
<i>Participants > 75%</i>			
Number eligible	92	172	385
Full time equivalent	72	143	366
Number fully eligible	43	113	327
<i>Non-participants</i>			
Number eligible	260	466	1,305
Full time equivalent	203	385	1,151
Number fully eligible	143	288	986
Comparison group			
Number eligible	382	689	2,024
Full time equivalent	300	570	1,823
Number fully eligible	212	440	1,557

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

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 Counts of beneficiaries are adjusted for CMHCB program eligibility during the entire Phase II demonstration period.

³ Number fully eligible is the number of beneficiaries that had no gap in the Phase II Health Buddy® West Program Demonstration eligibility during the demonstration period

SOURCES: 2008 – 2012 Medicare claims data, Medicare enrollment database.

Program: tableHBW-1

Table 3-2 presents participation rates for the three Phase II Health Buddy[®] West Program Demonstration populations and display the participation status of the beneficiary after verbal consent to participate was given (continuous participation or became a continuous nonparticipant after initial participation period). 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 demonstration staff 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, 35% verbally consented to participate in the Phase II program at some point during the intervention period (*Table 3-2*). Only 10% of beneficiaries were continuous participants, which equates to less than one-third of participants. Among the Phase I Population beneficiaries, 57% refused to participate. The percent not contacted or unable to be located was also 7%.

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[®] West Program Demonstration. Of the Phase I Original intervention beneficiaries, 23% participated for more than 75% of their eligible months, which is more than double the continuous participant percentage. *Table 3-2* also reports the number of participants over time (for months 6, 12, 24, and 34, the last month of the demonstration). The number of participants continually decreased throughout the demonstration time period 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. For the original population, beneficiaries had to have annual costs of \$6,000 or more and an HCC score greater than or equal to 1.7. For the Phase I Refresh population, those criteria were not used. Instead, the Health Buddy Consortium (HBC) specified tiers of qualification thresholds (based on beneficiary utilization of services) for each of the four diagnostic inclusion categories they specified (HF, DM, COPD, and co-morbidity). With the selection criterion change, there was no improvement in the participation rate, in fact it decreased during Phase I (McCall, et al., 2010). During Phase II, the participation rates were comparable between the Phase I Original and Refresh populations, 35% and 36% respectively.

Participation rates for the Phase II population. The criteria for selection of the intervention and comparison Phase II populations were similar to the criteria used to select the Phase I Refresh population. During Phase II, the participation rates were similar for the Phase II population (36%) and the two Phase I populations. However, the percentage of beneficiaries participating more than 75% of eligible months is lower than observed for the two Phase I populations, 19% versus 23% and 24%.

Table 3-2
Participation in the Phase II Health Buddy[®] West Program CMHCB Demonstration

Characteristics	Phase I Original	Phase I Refresh	Phase II population
Number of intervention months	34	34	34
Participation rate (entire demonstration period)	35%	36%	36%
Length of participation			
Continuous participation after engagement	10%	10%	12%
After initial participation, became a continuous non-participant	25%	26%	24%
Nonparticipation (never agreed)	65%	64%	64%
Refused to participate when contacted	57%	54%	51%
Not contacted/unable to be contacted	7%	10%	14%
Beneficiaries participating more than 75% of eligible months	23%	24%	19%
Number of participants in selected months			
Month 6	118	222	421
Month 12	98	178	529
Month 24	81	154	538
Month 34	28	62	224

NOTES: CMHCB = Care Management for High Cost Beneficiaries.

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.

Data Sources: Medicare claims data, Medicare enrollment database.

Program: tableHBW-2.sas

3.3.2 Characteristics of Participants in the Phase II Health Buddy[®] West Program 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[®] West Program 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.

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, respectively. 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 0.04 or less.

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

Characteristics	Demographic		Full Model B	
	Model A OR	<i>p</i> - <i>value</i> ³	OR	<i>p</i> - <i>value</i> ³
Intercept	0.25	**	0.24	**
Beneficiary characteristics				
Male	1.01	N/S	1.03	N/S
African American/other/unknown	0.30	N/S	0.28	N/S
Age < 65 years	1.64	N/S	1.68	N/S
Age 75-84	1.42	N/S	1.50	N/S
Age 85 + years	1.48	N/S	1.63	N/S
Medicaid	1.00	N/S	1.00	N/S
Baseline characteristics				
Baseline HCC score medium	N/I	N/I	1.21	N/S
Baseline HCC score high	N/I	N/I	0.61	N/S
Medium baseline PBPM payment	N/I	N/I	1.00	N/S
High baseline PBPM payment	N/I	N/I	1.07	N/S
Baseline Charlson score medium	N/I	N/I	1.16	N/S
Baseline Charlson score high	N/I	N/I	0.71	N/S
Demonstration period health status				
Died	N/I	N/I	1.30	N/S
Institutionalized	N/I	N/I	1.00	N/S
Model Fit				
Number of cases	402	N/A	402	N/A
Chi-square (<i>p</i> <)	4.46	N/S	12.32	N/S
Pseudo R-square	0.01	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 eligibility during the demonstration period.

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 <0.82. The age reference group is 65-74 years. The PBPM payment reference group is < \$284. The baseline Charlson score reference group is < 2.

Data Sources: RTI analysis of 2008-2012 Medicare enrollment, eligibility, claims and encounter data.

Program: bene04b rangesa partab4b partab3b

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

Characteristics	Demographic		Full Model B OR	<i>p</i> - <i>value</i> ³
	Model A OR	<i>p</i> - <i>value</i> ³		
Intercept	0.43	**	0.26	**
Beneficiary characteristics				
Male	0.79	N/S	0.81	N/S
African American/other/unknown	0.42	N/S	0.39	N/S
Age < 65 years	1.25	N/S	1.18	N/S
Age 75-84	0.97	N/S	0.94	N/S
Age 85 + years	0.56	*	0.57	N/S
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	0.76	N/S
Medium baseline PBPM payment	N/I	N/I	1.55	N/S
High baseline PBPM payment	N/I	N/I	1.21	N/S
Baseline Charlson score medium	N/I	N/I	1.13	N/S
Baseline Charlson score high	N/I	N/I	1.37	N/S
Demonstration period health status				
Died	N/I	N/I	1.34	N/S
Institutionalized	N/I	N/I	1.00	N/S
Model Fit				
Number of cases	726	N/A	726	N/A
Chi-square (<i>p</i> <)	11.63	N/S	26.75	*
Pseudo R-square	0.02	N/A	0.04	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 demonstration eligibility.

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 <0.89. The age reference group is 65-74 years. The PBPM payment reference group is < \$199. The baseline Charlson score reference group is < 2.

Data Sources: RTI analysis of 2008-2012 Medicare enrollment, eligibility, claims and encounter data.

Program: bene04b rangesa partab4b partab3b

Table 3-5
Logistic regression modeling results comparing beneficiaries that participated at least 75%
of eligible months during the Phase II Health Buddy® West Program CMHCB
Demonstration: Phase II population ^{1,2}

Characteristics	Demographic			
	Model A OR	<i>p</i> - <i>value</i> ³	Full Model B OR	<i>p</i> - <i>value</i> ³
Intercept	0.29	**	0.22	**
Beneficiary characteristics				
Male	0.93	N/S	0.98	N/S
African American/other/unknown	0.77	N/S	0.73	N/S
Age < 65 years	0.91	N/S	0.85	N/S
Age 75-84	0.96	N/S	0.97	N/S
Age 85 + years	0.60	*	0.64	*
Medicaid	1.00	N/S	1.00	N/S
Baseline characteristics				
Baseline HCC score medium	N/I	N/I	1.05	N/S
Baseline HCC score high	N/I	N/I	0.75	N/S
Medium baseline PBPM payment	N/I	N/I	1.23	N/S
High baseline PBPM payment	N/I	N/I	1.51	*
Baseline Charlson score medium	N/I	N/I	0.78	N/S
Baseline Charlson score high	N/I	N/I	1.14	N/S
Demonstration period health status				
Died	N/I	N/I	1.24	N/S
Institutionalized	N/I	N/I	1.00	N/S
Model Fit				
Number of cases	2,025	N/A	2,025	N/A
Chi-square (<i>p</i> <)	8.07	N/S	23.26	N/S
Pseudo R-square	0.00	N/A	0.01	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 demonstration eligibility.

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 <0.78. The age reference group is 65-74 years. The PBPM payment reference group is < \$178. The baseline Charlson score reference group is < 1.

Data Sources: RTI analysis of 2008-2012 Medicare enrollment, eligibility, claims and encounter data.

Program: bene04b rangesa partab4b partab3b

We do not observe any statistically significant results in either Model A or Model B for the Phase I Original population (**Table 3-3**). Note the relatively small number of participants for 75% of eligible months (23% of 402 eligible beneficiaries). Older beneficiaries were less likely to participate among the Phase I Refresh population (**Table 3-4**). However, after controlling for demonstration period health status and baseline characteristics, this finding is no longer statistically significant. Beneficiaries in the Phase II population were also less likely to participate if they were more than 85 years of age (**Table 3-5**). In the full model, beneficiaries with high baseline PBPM payments were more likely to participate when controlling for baseline demographics and demonstration period health status. As noted earlier, all models had low explanatory power.

3.3.3 Level of Intervention

In this section, we report the frequency of interaction between the Phase II intervention beneficiaries for a subset of intervention population beneficiaries who used the Health Buddy[®] device at any point during the Phase II Demonstration period. Encounter data were only provided for beneficiaries who used 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[®] West Program Demonstration to determine the breadth and depth of contacts related to care management. RTI received quarterly data from RBHC, but, only received eleven quarters of reported data representing information on beneficiaries who used the Health Buddy[®] device at any point during the first 33 months of the Phase II Demonstration. **Table 3-6** provides counts of beneficiaries that used the Health Buddy[®] device by quarter and the percent of eligible beneficiaries who used the device. Less than one-quarter of the Phase II Health Buddy[®] West Program Demonstration Phase I Original and Refresh intervention beneficiaries used the Health Buddy[®] device during the Phase II demonstration period, and only one-third of the Phase II population beneficiaries used the device at some point during the Phase II intervention period.

Table 3-6
Frequency and percentage of Phase II Health Buddy® West Program CMHCB
Demonstration eligible beneficiaries who used 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 used the device	313	77.9	549	75.6	1,393	68.8
1	73	18.2	141	19.4	250	12.3
2	73	18.2	126	17.4	403	19.9
3	69	17.2	127	17.5	447	22.1
4	68	16.9	132	18.2	461	22.8
5	57	14.2	124	17.1	416	20.5
6	59	14.7	120	16.5	420	20.7
7	58	14.4	117	16.1	401	19.8
8	54	13.4	106	14.6	384	19.0
9	47	11.7	103	14.2	362	17.9
10	44	10.9	97	13.4	341	16.8
11	40	10.0	85	11.7	298	14.7

NOTES: CMHCB = Care Management for High Cost Beneficiaries.

Data Sources: RTI analysis of 2008-2012 Medicare enrollment, eligibility, and RBHC encounter data.

Program: enctabl

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 142 Phase I Original population beneficiaries that agreed to participate in the Phase II Demonstration. Of these, 89 (63%) agreed to use the device for at least 1 quarter during the 33 month period examined using the encounter data. On average, beneficiaries had the device for 8 of the 11 quarters and completed 341 surveys, which equates to about 43 surveys per quarter. Of the 341 surveys, 67 (20%) 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 260 beneficiaries that agreed to participate in the Phase II Demonstration. Of these, 177 (68%) agreed to use the device for at least 1 quarter during the 33-month period. On average, beneficiaries had the device for 8 of the 11 quarters and completed 371 surveys, which equates to about 34 surveys per quarter. Of those 371 surveys, 78 (21%) included high risk responses.

Table 3-7 also shows that, of the 720 Phase II population beneficiaries that agreed to participate, 632 agreed to use the Health Buddy[®] device (88%). On average, beneficiaries had the device for 7 of the 11 quarters and completed 299 surveys (about 27 surveys per quarter). Nearly 18% of those surveys were high risk responses.

The Phase II Health Buddy[®] West Program Demonstration provided data on the number of telephonic contacts per beneficiary 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 67% of contacts for the Phase I Refresh population to nearly 72% of the Phase II population. Calls from the patient to the care manager were the second most frequent 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 = 89). It also provides the overall distribution of telephonic contacts for the original population. Observations were weighted by the fraction of eligible days, which resulted in 76 full-time equivalent beneficiaries. The mean number of contacts for each beneficiary was 43 and the median was 31. On average, there was at least one telephonic correspondence with or regarding the beneficiary in 7 of the 11 quarters. One-quarter of beneficiaries had less than 14 contacts and nearly 36% of beneficiaries had 36 or more contacts over the 11-quarter period. **Table 3-9** also displays this same information for the Phase I Refresh population. A total of 177 unique Phase I Refresh population beneficiaries met the inclusion criteria for this analysis (155 full-time equivalents). The refresh population had a slightly higher percentage of beneficiaries with less than 14 contacts (28%) and a higher percentage of beneficiaries with 36 or more contacts (42%).

The Phase II population had a total of 632 beneficiaries (588 full-time equivalents) that used the Health Buddy[®] device. On average, a beneficiary had 38 contacts over the 11 months of the Phase II Demonstration period (**Table 3-9**). This population had a higher percentage of beneficiaries with less than 14 contacts (35%) and a lower percentage of beneficiaries with 36 or more contacts (33%).

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	
	Mean	Median	Mean	Median	Mean	Median
Number of beneficiaries with the Health Buddy® device ¹	89	—	177	—	632	—
FTE beneficiaries with the Health Buddy® device ²	76	—	155	—	588	—
<u>Measures of Health Buddy® device utilization</u>	Mean	Median	Mean	Median	Mean	Median
Number of quarters with the Health Buddy® device	8	9	8	9	7	7
Number of completed surveys	341	300	371	303	299	219
Number of high risk knowledge responses	1	0	1	0	1	0
Number of high risk behavior responses	7	3	12	4	7	3
Number of high risk symptoms responses	55	28	59	30	43	20
Number of high risk general responses	4	2	6	1	2	1
Number of total high risk responses	67	36	78	40	53	26

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 2008-2012 Medicare enrollment, eligibility, and RBHC encounter data.

Program: enctab2, enctab3

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

Contacted	Phase I Original		Phase I Refresh		Phase II population	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Outbound total	2,504	75.9	5,992	75.3	17,370	78.3
Patient	2,339	70.9	5,335	67.0	15,894	71.6
Physician	165	5.0	657	8.2	1,475	6.6
Inbound total	796	24.1	1,967	24.7	4,821	21.7
Patient to Care						
Manager	631	19.1	1,311	16.5	3,346	15.1
Physician to Care						
Manager	165	5.0	657	8.2	1,475	6.6
Total contacts	3,300	100.0	7,959	100.0	22,190	100.0

NOTES: CMHCB = Care Management for High Cost Beneficiaries.

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 2008-2012 Medicare enrollment, eligibility, and RBHC encounter data.

Program: enctab2

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

Statistic	Phase I Original		Phase I Refresh		Phase II population	
	Number	Percent	Number	Percent	Number	Percent
Mean number of contacts	43	—	51	—	38	—
Median number of contacts	31	—	35	—	29	—
Mean number of quarters of contact	7	—	7	—	6	—
Median number of quarters of contact	8	—	7	—	6	—
Distribution low to high contact variables	FTE beneficiaries	Percent	FTE beneficiaries	Percent	FTE beneficiaries	Percent
0-13 contacts	20	25.8%	44	28.4%	203	34.5%
14-35 contacts	29	38.1%	46	29.7%	194	33.0%
36+ contacts	28	36.1%	65	41.9%	191	32.6%
Total	76	100.0%	155	100.0%	588	100.0%

NOTES: CMHCB = Care Management for High Cost Beneficiaries; 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 2008-2012 Medicare enrollment, eligibility, and RBHC encounter data.

Program: enctab2 enctab3.sas

Table 3-10 displays the percentage of Health Buddy[®] device participants with care manager interactions – telephone contacts inbound and outbound, and any contact (all telephonic) by frequency of contact over 33 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 (95% compared to 83% for inbound contact) and nearly 64% have 20 or more outbound calls compared to inbound contacts (15%). About 4% of beneficiaries had no telephonic contact, with only 16% of beneficiaries having less than 10 contacts during the 33-month period. Nearly 84% had 10 or more telephonic contacts of some form. This indicates that beneficiaries with the Health Buddy[®] device were in 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 lowest rate of beneficiaries with no contact (1%). Phase II population beneficiaries also 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 the group's tertile values. Only among the Phase II population beneficiaries do we observe a pattern that the beneficiaries with the highest HCC scores have the greatest level of contact with program staff. Among the Phases II population, the percentage of beneficiaries with 20 or more telephone contacts increases from 60% for the low HCC risk group to 71% among the high HCC risk group.

Table 3-10
Percent distribution of participants¹ with Phase II Health Buddy[®] West Program CMHCB Demonstration care manager interactions

Type and frequency of contact	Number of Phase I Original FTE beneficiaries ²		Number of Phase I Refresh FTE beneficiaries ²		Number of Phase II population FTE beneficiaries ²	
		Percent		Percent		Percent
Telephonic inbound						
0	13	16.9	21	13.4	75	12.7
1	8	10.8	14	9.1	67	11.3
2-4	12	15.4	42	27.1	143	24.3
5-9	14	18.9	25	16.2	134	22.7
10-19	17	22.6	25	16.2	103	17.5
20+	12	15.4	28	18.0	67	11.4
Telephonic outbound						
0	4	5.2	5	3.0	12	2.0
1	1	1.6	1	0.8	21	3.6
2-4	3	4.4	14	9.1	51	8.7
5-9	5	7.2	11	7.3	65	11.0
10-19	14	17.8	23	15.1	113	19.2
20+	49	63.8	100	64.7	326	55.5
Any telephonic contact						
0	3	3.9	3	1.7	6	1.1
1	1	1.6	2	1.4	14	2.3
2-4	4	4.7	11	7.2	42	7.1
5-9	5	6.1	12	7.6	65	11.1
10-19	9	12.0	18	11.6	88	14.9
20+	55	71.7	109	70.5	374	63.5

NOTES: CMHCB = Care Management for High Cost Beneficiaries; 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 2008-2012 Medicare enrollment, eligibility, and RBHC encounter data.

Program: enctab4

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

Contact mode	HCC Score Low (<0.82) N = 9.5 ¹		HCC Score Medium (0.82-2.05) N = 42.5 ¹		HCC Score High (>2.05) N = 24 ¹	
	Frequency	%	Frequency	%	Frequency	%
Telephonic inbound						
0	2.2	23.1	4.4	10.3	6.3	25.9
1	0.0	0.0	4.7	11.0	3.6	14.6
2-4	0.6	6.5	7.9	18.6	3.2	13.3
5-9	1.0	10.5	6.9	16.1	6.6	27.2
10-19	4.0	42.0	11.3	26.6	2.0	8.1
20+	1.7	18.0	7.4	17.4	2.7	11.0
Telephonic outbound						
0	1.0	10.5	1.0	2.4	2.0	8.2
1	0.2	2.1	1.0	2.4	0.0	0.0
2-4	0.0	0.0	3.2	7.5	0.2	0.9
5-9	0.0	0.0	2.6	6.1	2.9	11.8
10-19	2.6	27.5	6.0	14.1	5.0	20.5
20+	5.7	60.0	28.8	67.6	14.3	58.7
Total telephonic						
0	1.0	10.5	1.0	2.4	1.0	4.1
1	0.2	2.1	0.0	0.0	1.0	4.1
2-4	0.0	0.0	3.4	8.0	0.2	0.9
5-9	0.0	0.0	1.8	4.2	2.9	11.8
10-19	0.6	6.5	4.6	10.8	4.0	16.4
20+	7.7	81.0	31.8	74.7	15.3	62.8

NOTES: CMHCB = Care Management for High Cost Beneficiaries; 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 2008-2012 Medicare enrollment, eligibility, and RBHC encounter data.
Program: enctab4.sas

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

Contact mode	HCC Score Low (<0.89) N = 41 ¹		HCC Score Medium (0.89-1.81) N = 79 ¹		HCC Score High (>1.81) N = 35 ¹	
	Frequency	%	Frequency	%	Frequency	%
Telephonic inbound						
0	4	10.5	11	14.4	5	14.6
1	5	11.8	5	5.7	5	13.2
2-4	14	33.5	19	24.6	9	25.1
5-9	7	17.3	15	19.1	3	8.6
10-19	7	17.5	14	18.3	4	10.0
20+	4	9.3	14	17.9	10	28.6
Telephonic outbound						
0	2	4.3	3	3.6	0	0.0
1	0	0.0	1	1.5	0	0.0
2-4	4	10.9	5	5.9	5	14.4
5-9	2	4.8	6	7.5	4	9.9
10-19	8	20.1	10	12.6	5	14.9
20+	25	59.9	54	68.9	21	60.7
Total telephonic						
0	1	1.8	2	2.3	0	0.0
1	1	2.4	1	1.5	0	0.0
2-4	2	6.0	5	5.9	4	11.6
5-9	4	9.7	4	5.5	4	9.9
10-19	5	12.2	9	11.4	4	11.2
20+	28	67.9	58	73.4	24	67.3

NOTES: CMHCB = Care Management for High Cost Beneficiaries; 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 2008-2012 Medicare enrollment, eligibility, and RBHC encounter data.
 Program: enctab4.sas

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

Contact mode	HCC Score Low (<0.78) N = 231 ¹		HCC Score Medium (0.78-1.43) N = 207 ¹		HCC Score High (>1.43) N = 151 ¹	
	Frequency	%	Frequency	%	Frequency	%
Telephonic inbound						
0	27	11.5	22	10.6	26	17.4
1	31	13.4	20	9.9	15	10.3
2-4	58	25.1	55	26.6	30	19.7
5-9	53	23.0	46	22.4	34	22.6
10-19	42	18.3	38	18.3	23	15.3
20+	20	8.7	25	12.2	22	14.7
Telephonic outbound						
0	7	2.8	3	1.4	2	1.3
1	7	3.0	11	5.3	3	2.3
2-4	22	9.5	19	9.2	10	6.7
5-9	27	11.5	24	11.4	15	9.8
10-19	49	21.2	38	18.3	26	17.5
20+	120	52.0	112	54.3	94	62.4
Total telephonic						
0	4	1.8	1	0.5	1	0.7
1	4	1.9	6	2.9	3	2.3
2-4	16	6.8	18	8.7	8	5.4
5-9	32	13.9	22	10.4	12	7.7
10-19	36	15.5	32	15.5	20	13.2
20+	139	60.2	128	62.1	107	70.8

NOTES: CMHCB = Care Management for High Cost Beneficiaries; 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 2008-2012 Medicare enrollment, eligibility, and RBHC encounter data.
Program: enctab4.sas

To more directly examine the targeting strategy of the Phase II Health Buddy[®] West Program 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 PBPM payments, and demonstration health status. Beneficiaries were weighted by their period of eligibility during demonstration, and their number of contacts categorized either as low (0-17) or high (45+). Odds ratios are partial in the sense that all other variables are held constant. For example, the odds of a Phase II population beneficiary in the high baseline HCC category experiencing a high contact rate are 1.56 times greater than for a beneficiary in the low baseline HCC category, adjusting for any baseline difference in PBPM costs and other characteristics.

Among the Phase I Original population, there were no beneficiary characteristics or baseline characteristics found to be a statistically significant indicator of the likelihood of being in the high contact category (**Table 3-14**). Demonstration period health status was also not a strong predictor of a high level of contact. The explanatory power of the studied beneficiary characteristics was 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 0.15. Another challenge to finding statistically significant results is the very low number of observations: there are 29 beneficiaries in the low contact category and 30 in the high contact group. These numbers become even smaller once they are weighted by eligibility (20 and 28, respectively).

For the Phase I Refresh population (**Table 3-14**), none of the beneficiary or baseline characteristics were found to be statistically significant indicators of the likelihood of being in the high contact category. However, among the demonstration period health status characteristics beneficiaries that died were found to be less likely to be in the high contact category while participants are more likely to be in the high contact category if they had one intervention period hospitalization. Again, this model faced the challenge of a very small numbers of observations (53 beneficiaries in the low contact category and 69 in the high contact category). Participants in the Phase II population are more likely to be in the high contact category if they were less than 65 years of age, or eligible for Medicare because of a disability, had high baseline HCC scores, and had one intervention period hospitalization (**Table 3-14**).

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

Characteristics	Phase I Original population OR ^{1,2,4}	<i>p-value</i> ³	Phase I Refresh population OR ^{1,2,5}	<i>p-value</i> ³	Phase II population OR ^{1,2,6}	<i>p-value</i> ³
Intercept	0.19	N/S	0.19	**	0.28	**
Beneficiary characteristics						
Male	1.10	N/S	0.71	N/S	0.83	N/S
Age <65	6.83	N/S	0.96	N/S	3.18	**
Age 75-84	1.43	N/S	1.49	N/S	1.34	N/S
Age 85+ years	0.29	N/S	2.06	N/S	1.06	N/S
Baseline characteristics						
Baseline HCC score medium	1.39	N/S	1.85	N/S	1.52	N/S
Baseline HCC score high	0.49	N/S	2.68	N/S	1.56	*
Medium base PBPM payment	1.66	N/S	1.45	N/S	1.32	N/S
High base PBPM payment	0.88	N/S	0.71	N/S	1.53	N/S
Baseline Charlson score medium	1.67	N/S	1.37	N/S	0.85	N/S
Baseline Charlson score high	1.26	N/S	2.84	N/S	0.89	N/S
Demonstration period health status						
Died	3.60	N/S	0.31	*	0.57	N/S
Institutionalized	1.00	N/S	1.00	N/S	1.00	N/S
One hospitalization	2.73	N/S	2.68	*	1.14	*
Multiple hospitalizations	1.79	N/S	2.64	N/S	1.81	N/S

(continued)

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

Characteristics	Phase I Original population OR ^{1,2,4}	<i>p-value</i> ³	Phase I Refresh population OR ^{1,2,5}	<i>p-value</i> ³	Phase II population OR ^{1,2,6}	<i>p-value</i> ³
Number of cases	89	N/A	177	N/A	632	N/A
Chi-square (p<)	13.96	N/S	21.94	N/S	33.16	*
Pseudo R2	0.15	N/A	0.12	N/A	0.05	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 <0.82. The age reference group is 65-74 years. The PBPM payment reference group is < \$284. The baseline Charlson score reference group is < 2.

⁵ The baseline HCC score reference group is <0.89. The age reference group is 65-74 years. The PBPM payment reference group is < \$199. The baseline Charlson score reference group is < 2.

⁶ The baseline HCC score reference group is <0.78. The age reference group is 65-74 years. The PBPM payment reference group is < \$178. The baseline Charlson score reference group is < 1.

Data Sources: RTI analysis of 2008-2012 Medicare enrollment, eligibility, claims and encounter data.

Programs: enctab3 enctab5

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3.4 Summary

For the Phase II Health Buddy[®] West Program Demonstration, we found few indicators predicting long-term participation. Within the Phase I Original population, there were no statistically significant indicators of participation and among the Phase II Refresh population, beneficiaries age 85 and older were less likely to participate, but this result lost significance after controlling for baseline characteristics and demonstration period utilization. For the Phase II population, we found that Medicare beneficiaries age 85 and older during the Phase II demonstration period were less likely to be long-term participants. At the same time, we observed that beneficiaries who were predicted to be the most costly during the year prior to the start of Phase II were more likely to be long-term participants.

A cornerstone of the HBC's program was the Health Buddy[®] device and interactions with care managers; however, less than one-quarter of the Phase II Health Buddy[®] West Program Demonstration Phase I Original and Refresh intervention beneficiaries used the Health Buddy[®] device during the Phase II demonstration period, and only one-third of the Phase II population beneficiaries used the device at some point during the Phase II intervention period. Of the beneficiaries participating in the program and using the Health Buddy[®] device, nearly all beneficiaries received at least one call from a care manager during the demonstration and roughly two-thirds of beneficiaries received more than 20 contacts during this same time period. Other than routine contact with the Health Buddy[®] device, outbound telephone contact with the care managers 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 original population, we found that beneficiary characteristics, baseline characteristics, and demonstration period acute care utilization were not strong indicators of being in the high contact category. The small sample sizes made it difficult to determine statistically significant differences.

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CHAPTER 4 CLINICAL QUALITY of CARE PERFORMANCE

4.1 Introduction

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

- *Clinical Quality of Care:* Did the Phase II Health Buddy[®] West 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[®] West 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[®] West 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 the 12-month period immediately prior to the beginning of the Phase II demonstration period for the all three populations (the start date was April 1, 2009 for all three populations). These measures were constructed for the initial 12 months of analyses (months 7-18) and the last 12 months of analyses (months 23-34) for all three groups. 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[®] West Program CMHCB Demonstration

Statistics	All	Diabetes	Ischemic vascular disease
Phase I Original beneficiaries			
Months 7-18			
Intervention			
Total number of beneficiaries	386	208	107
Full time equivalents ¹	349	186	90
Comparison			
Total number of beneficiaries	366	183	124
Full time equivalents ¹	329	165	106
Months 23-34			
Intervention			
Total number of beneficiaries	312	154	74
Full time equivalents ¹	278	136	64
Comparison			
Total number of beneficiaries	289	138	82
Full time equivalents ¹	257	125	71
Phase I Refresh beneficiaries			
Months 7-18			
Intervention			
Total number of beneficiaries	705	340	194
Full time equivalents ¹	656	316	177
Comparison			
Total number of beneficiaries	664	307	204
Full time equivalents ¹	613	283	183
Months 23-34			
Intervention			
Total number of beneficiaries	605	277	143
Full time equivalents ¹	544	256	127
Comparison			
Total number of beneficiaries	554	250	151
Full time equivalents ¹	510	233	134

(continued)

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

Statistics	All	Diabetes	Ischemic vascular disease
Phase II population beneficiaries			
Months 7-18			
Intervention			
Total number of beneficiaries	1,995	662	778
Full time equivalents ¹	1,898	620	737
Comparison			
Total number of beneficiaries	1,998	676	800
Full time equivalents ¹	1,913	639	756
Months 23-34			
Intervention			
Total number of beneficiaries	1,811	552	685
Full time equivalents ¹	1,712	524	659
Comparison			
Total number of beneficiaries	1,801	582	695
Full time equivalents ¹	1,730	550	666

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 2008-2012 Medicare enrollment, eligibility, claims and encounter data; Computer runs: basedx, gcc01, gcc02, gcctab, gcc_rob, gcctabx, gcctab1, acsc02

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[®] West Program 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 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 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) for both the 12-month initial analysis period and the last 12-month analysis period. 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® West Program 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 <i>p-value</i>	D-in-D CI Low	D-in-D CI High
Phase I Original population									
Months 7-18									
Beneficiaries with diabetes									
HbA1c test	95	93	92	81	8.22	1.73	0.31	0.60	5.03
LDL-C test	83	73	77	68	-0.92	0.88	0.70	0.45	1.73
Eye Exam	75	61	65	67	-16.07	0.48	0.02	0.26	0.88
Nephropathy	70	48	63	42	-1.81	0.90	0.72	0.49	1.63
All 4 measures	49	23	36	20	-10.31	0.68	0.25	0.36	1.31
None of the 4 measures	1	3	1	5	-1.94	0.79	0.83	0.09	6.74
Beneficiaries with IVD ²									
Lipid Panel	75	69	70	64	-0.87	0.93	0.87	0.41	2.14
Phase I Original population									
Months 23-34									
Beneficiaries with diabetes									
HbA1c test	95	92	91	93	-5.20	0.44	0.22	0.12	1.63
LDL-C test	84	76	78	70	0.19	0.92	0.85	0.41	2.07
Eye Exam	79	60	63	67	-23.95	0.32	0.00	0.16	0.66
Nephropathy	70	53	60	46	-2.20	0.88	0.72	0.44	1.75
All 4 measures	51	26	35	24	-13.45	0.59	0.16	0.28	1.22
None of the 4 measures	1	4	4	5	1.98	4.53	0.23	0.39	52.98
Beneficiaries with IVD ²									
Lipid Panel	76	67	70	65	-3.95	0.80	0.67	0.29	2.19
Phase I Refresh population									
Months 7-18									
Beneficiaries with diabetes									
HbA1c test	95	90	92	85	1.43	0.88	0.77	0.39	1.99
LDL-C test	84	74	78	71	-4.03	0.74	0.26	0.43	1.26
Eye Exam	72	61	69	57	1.74	1.06	0.81	0.67	1.69
Nephropathy	68	48	58	47	-9.32	0.67	0.08	0.43	1.05
All 4 measures	45	29	35	26	-6.11	0.80	0.35	0.50	1.28
None of the 4 measures	1	3	1	6	-2.96	0.33	0.23	0.05	2.03
Beneficiaries with IVD ²									
Lipid Panel	78	68	71	68	-7.05	0.69	0.24	0.36	1.29
Phase I Refresh population									
Months 23-34									
Beneficiaries with diabetes									
HbA1c test	96	91	89	86	-0.92	0.65	0.35	0.27	1.60
LDL-C test	86	77	76	67	0.62	0.87	0.64	0.48	1.58
Eye Exam	71	61	62	55	-2.08	0.89	0.64	0.54	1.47
Nephropathy	70	48	60	47	-8.57	0.68	0.13	0.41	1.12
All 4 measures	46	30	31	21	-5.50	0.87	0.62	0.51	1.50
None of the 4 measures	1	4	2	6	-0.87	1.88	0.49	0.31	11.56
Beneficiaries with IVD ²									
Lipid Panel	80	70	73	69	-6.27	0.69	0.34	0.33	1.47

(continued)

Table 4-2 (continued)
Comparison of rates of guideline concordant care for the last 12 months of the Phase II Health Buddy® West Program 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 <i>p-value</i>	D-in-D CI Low	D-in-D CI High
Phase II population									
Months 7-18									
Beneficiaries with diabetes									
HbA1c test	96	95	91	85	4.28	1.23	0.52	0.66	2.30
LDL-C test	88	80	81	75	-1.84	0.78	0.22	0.52	1.17
Eye Exam	67	61	65	57	2.74	1.11	0.51	0.81	1.54
Nephropathy	71	57	62	50	-3.21	0.84	0.28	0.61	1.16
All 4 measures	44	31	38	27	-1.64	0.97	0.85	0.70	1.34
None of the 4 measures	1	2	3	5	-1.35	1.34	0.64	0.39	4.67
Beneficiaries with IVD ²									
Lipid Panel	86	79	81	79	-5.06	0.69	0.05	0.48	0.99
Phase II population									
Months 23-34									
Beneficiaries with diabetes									
HbA1c test	96	95	91	88	2.13	1.03	0.93	0.51	2.10
LDL-C test	90	80	79	75	-5.33	0.59	0.02	0.38	0.93
Eye Exam	68	61	69	60	2.06	1.10	0.61	0.77	1.56
Nephropathy	72	56	61	51	-5.05	0.77	0.15	0.55	1.09
All 4 measures	48	32	39	28	-3.99	0.88	0.46	0.62	1.25
None of the 4 measures	0	2	2	4	-0.15	2.44	0.26	0.51	11.55
Beneficiaries with IVD ²									
Lipid Panel	88	80	78	74	-3.14	0.72	0.09	0.49	1.05

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.

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® West Program 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 is defined using the National Qualify Forum definition.

SOURCE: RTI analysis of 2008-2012 Medicare enrollment, eligibility, claims and encounter data; Computer runs: basedx, gcc01, gcc02, gcc_rob, gcc01, gcc02, gcc03, gcc04, gcc05, gcc06, gcc07, gcc08, gcc09, gcc10, gcc11, gcc12, gcc13, gcc14, gcc15, gcc16, gcc17, gcc18, gcc19, gcc20, gcc21, gcc22, gcc23, gcc24, gcc25, gcc26, gcc27, gcc28, gcc29, gcc30, gcc31, gcc32, gcc33, gcc34, gcc35, gcc36, gcc37, gcc38, gcc39, gcc40, gcc41, gcc42, gcc43, gcc44, gcc45, gcc46, gcc47, gcc48, gcc49, gcc50, gcc51, gcc52, gcc53, gcc54, gcc55, gcc56, gcc57, gcc58, gcc59, gcc60, gcc61, gcc62, gcc63, gcc64, gcc65, gcc66, gcc67, gcc68, gcc69, gcc70, gcc71, gcc72, gcc73, gcc74, gcc75, gcc76, gcc77, gcc78, gcc79, gcc80, gcc81, gcc82, gcc83, gcc84, gcc85, gcc86, gcc87, gcc88, gcc89, gcc90, gcc91, gcc92, gcc93, gcc94, gcc95, gcc96, gcc97, gcc98, gcc99, gcc100, gcc101, gcc102, gcc103, gcc104, gcc105, gcc106, gcc107, gcc108, gcc109, gcc110, gcc111, gcc112, gcc113, gcc114, gcc115, gcc116, gcc117, gcc118, gcc119, 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gcc870, gcc871, gcc872, gcc873, gcc874, gcc875, gcc876, gcc877, gcc878, gcc879, gcc880, gcc881, gcc882, gcc883, gcc884, gcc885, gcc886, gcc887, gcc888, gcc889, gcc890, gcc891, gcc892, gcc893, gcc894, gcc895, gcc896, gcc897, gcc898, gcc899, gcc900, gcc901, gcc902, gcc903, gcc904, gcc905, gcc906, gcc907, gcc908, gcc909, gcc910, gcc911, gcc912, gcc913, gcc914, gcc915, gcc916, gcc917, gcc918, gcc919, gcc920, gcc921, gcc922, gcc923, gcc924, gcc925, gcc926, gcc927, gcc928, gcc929, gcc930, gcc931, gcc932, gcc933, gcc934, gcc935, gcc936, gcc937, gcc938, gcc939, gcc940, gcc941, gcc942, gcc943, gcc944, gcc945, gcc946, gcc947, gcc948, gcc949, gcc950, gcc951, gcc952, gcc953, gcc954, gcc955, gcc956, gcc957, gcc958, gcc959, gcc960, gcc961, gcc962, gcc963, gcc964, gcc965, gcc966, gcc967, gcc968, gcc969, gcc970, gcc971, gcc972, gcc973, gcc974, gcc975, gcc976, gcc977, gcc978, gcc979, gcc980, gcc981, gcc982, gcc983, gcc984, gcc985, gcc986, gcc987, gcc988, gcc989, gcc990, gcc991, gcc992, gcc993, gcc994, gcc995, gcc996, gcc997, gcc998, gcc999, gcc1000.

At baseline across all populations, beneficiaries with diabetes in the intervention group had individual measures of diabetes care with rates ranging from 68% for nephropathy screening to 96% for HbA1c testing. Nearly half of the beneficiaries in all groups received all 4 diabetes measures and 99% of beneficiaries received at least one of the four measures. The rate of receipt of an annual lipid panel among intervention beneficiaries with IVD ranged from 75% to 88%. Comparison group beneficiaries with diabetes or IVD generally had lower rates of receipt of each measure at baseline.

Over the course of the Phase II demonstration period for the Phase I Original population, most rates decreased with all D-in-D estimates not being statistically significant with one exception; there was an increase in the rate of eye exams for the comparison group in both time periods examined; however their baseline rates were greater than 10 percentage points lower than the intervention group's baseline rates providing greater opportunity for impact. The -16 per 100 beneficiaries ($p=0.02$) and the -24 per 100 beneficiaries ($p<0.01$) D-in-D estimates reflect the combined decline in the intervention group's rates and the increase in the comparison group's rates. We observe only modest separation in the difference-in-differences rates among the other measures with no differences being statistical significant.

Over the course of the demonstration period for the Phase I Refresh population, we again observe the general pattern of a decline in the rates across both time periods. The D-in-D estimates varied by no more than 10 percentage points but were generally negative due to a larger decline in receipt of the diabetes and IVD care measures among intervention beneficiaries. None of the D-in-D rates are statistically significant.

As with the two sets of Phase I beneficiaries, we observe a similar pattern of declining rate of receipt of the diabetes and IVD care measures during both demonstration periods among both the intervention and comparison beneficiaries; however, the D-in-D rates varied by 5 percentage points or less for the Phase II population. There were two statistically significant differences. During months 7 to 18 of the Phase II demonstration period, the rate of receipt of a LDL-C test among beneficiaries with diabetes declined by 5 percentage points within the intervention group and remained constant within the comparison group yielding a -5 per 100 D-in-D rate ($p=0.05$). During months 23 to 34 of the Phase II demonstration period, the LDL-C screening rate among beneficiaries with diabetes declined by 11 percentage points within the intervention group and 5 percentage points within the comparison group yielding a -5 per 100 D-in-D rate ($p=0.02$).

4.4 Summary of Findings and Conclusion

In this chapter, we reported the effect of the Phase II Health Buddy[®] West Program Demonstration on selected quality of care measures. Specifically, we reported findings for the key research question: did the Phase II Health Buddy[®] West Program 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[®] West Program Demonstration, which was not a performance metric in the Phase II Health Buddy[®] West Program Demonstration. For a number of the quality of care measures, we are likely observing a ceiling effect. However, there is considerable room for improvement for several of the diabetes measures and for the composite measure that considers receipt of all four diabetes measures. We found four instances of statistically significant rate of receipt differences between the intervention and comparison groups out of 42 comparisons; all signaling a negative intervention effect. 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[®] West Demonstration improve intermediate health outcomes by reducing acute hospitalizations, readmissions, or emergency room (ER) utilization?
- Did the Phase II Health Buddy[®] West 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[®] West Demonstration during the initial 12 months and 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 immediately preceding the start of Phase II. 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 (April 1, 2008 through March 31, 2009). These rates were also constructed for the initial 12 months of the Phase II demonstration (months 7-18) and for the final 12 months of the Phase II demonstration (months 23-34) for all three populations. 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 and generated a 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[®] West Demonstration eligibility criteria in the baseline and demonstration periods and to adjust for potential baseline differences between the intervention and comparison groups.

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 periods for the three populations examined admissions during the months 7 through 18, which included readmissions through month 21, and months 20 through 31, which included readmissions through month 34.

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 program 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[®] West Program 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 (*p-value*) as well as the high and low 95% confidence interval thresholds for the IRR.

Not unexpectedly, the baseline rates of hospitalization and ER visits are highest among the Phase I Original intervention and comparison populations. The rates are lowest among beneficiaries newly identified for Phase II. The baseline rate of all-cause hospitalization was 648 per 1,000 Phase I Original intervention group beneficiaries when evaluating the beneficiaries who participated in the demonstration during months 7 through 18 of Phase II. The baseline rate of all-cause ER visits was 1,288 per 1,000 Phase I Original intervention beneficiaries. Both sets of acute care utilization rates are lower than those observed for comparison group beneficiaries. The ACSC reasons for hospitalization combined accounted for just under half of all-cause hospitalizations and 39% of all-cause ER visits. Thus, Medicare FFS beneficiaries in the program were being treated in acute care settings for many 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 rate is positive for all-cause hospitalizations and ER visits and for ACSC ER visits. These findings indicate that the rate of acute care utilization for the comparison group grew more slowly than for the intervention group. The ACSC hospitalization rate has a negative D-in-D value, indicating a slower increase in the rate for the intervention group than the comparison group. None of the differences are statistically significant.

We observe the same high rates of baseline utilization for the Phase I Original intervention and comparison populations for the final 12 months of analysis. The baseline rate of all-cause hospitalization was 528 per 1,000 Phase I Original intervention group beneficiaries. The baseline rate of all-cause ER visits was 1,194 per 1,000 Phase I Original intervention beneficiaries. The ACSC reasons for hospitalization combined accounted for 43% of all-cause hospitalizations and 40% of all-cause ER visits. Again, 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 rate is negative for all-cause and ACSC hospitalizations and ACSC ER visits indicating that the rate for the intervention group grew more slowly than the comparison group. Conversely, the D-in-D rate is positive for all-cause ER visits, indicating a slower increase in rates for the comparison group relative to the intervention 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**. For both the initial 12 months and last 12 months of analysis, 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 for both time periods. For the final 12 months of analysis, we find statistically significant lower rates of growth in all-cause hospitalizations and all-cause and ACSC ER visits, indicating a positive intervention effect.

Table 5-1
Comparison of rates of utilization for months 7-18 and the last 12 months of the Phase II Health Buddy® West Program 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	<i>p-value</i>	Low CI	High CI
Phase I Original									
Months 7-18									
Hospitalizations									
All cause	648	721	878	897	54	1.09	0.62	0.78	1.53
All ACSCs	311	364	439	553	-61	0.93	0.76	0.59	1.47
ER/Obs visits									
All cause	1,288	1,421	1,861	1,715	280	1.20	0.25	0.88	1.63
All ACSCs	506	544	777	705	109	1.18	0.42	0.78	1.79
Months 23-34									
Hospitalizations									
All cause	528	627	814	1,035	-122	0.93	0.73	0.63	1.38
All ACSCs	229	317	447	593	-57	1.05	0.87	0.60	1.82
ER/Obs visits									
All cause	1,194	1,352	2,025	1,946	237	1.18	0.34	0.84	1.65
All ACSCs	481	497	876	895	-3	1.01	0.96	0.65	1.58
Phase I Refresh									
Months 7-18									
Hospitalizations									
All cause	535	561	684	737	-26	0.97	0.86	0.73	1.29
All ACSCs	267	259	372	421	-58	0.86	0.42	0.59	1.25
ER/Obs visits									
All cause	1,224	1,236	1,497	1,603	-93	0.94	0.64	0.74	1.20
All ACSCs	444	485	618	709	-49	0.95	0.78	0.69	1.32
Months 23-34									
Hospitalizations									
All cause	507	478	604	847	-272	0.67	0.02	0.48	0.95
All ACSCs	226	205	336	476	-161	0.64	0.06	0.40	1.02
ER/Obs visits									
All cause	1,166	1,088	1,389	1,907	-595	0.68	0.01	0.50	0.92
All ACSCs	392	407	539	814	-259	0.69	0.05	0.48	0.99

(continued)

Table 5-1 (continued)
Comparison of rates of utilization for months 7-18 and the last 12 months of the Phase II Health Buddy® West Program 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	<i>p-value</i>	Low CI	High CI
Phase II population									
Months 7-18									
Hospitalizations									
All cause	500	544	557	588	14	1.03	0.73	0.86	1.23
All ACSCs	162	197	228	250	11	1.10	0.52	0.82	1.48
ER/Obs visits									
All cause	1,000	1,057	1,163	1,209	10	1.02	0.85	0.85	1.21
All ACSCs	301	348	375	436	-14	1.00	0.97	0.78	1.26
Months 23-34									
Hospitalizations									
All cause	459	516	485	516	25	1.05	0.60	0.87	1.29
All ACSCs	130	174	212	240	16	1.18	0.30	0.86	1.63
ER/Obs visits									
All cause	940	975	1216	1252	-1	1.01	0.94	0.83	1.22
All ACSCs	261	320	418	476	2	1.08	0.55	0.84	1.39

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® West Demonstration.

² Rates are per 1,000 beneficiaries adjusted for periods of Phase II Health Buddy® West Demonstration eligibility for the 1-year period prior to the start of the demonstration and for Phase II Health Buddy® West Program 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 2008-2012 Medicare enrollment, eligibility, claims and encounter data; Computer runs: acsc01 acsc02 acstab acsc acstab1

Lastly, **Table 5-1** presents hospitalization and ER visits rates per 1,000 Phase II population beneficiaries. For both the initial 12 months and final 12 months of analysis, the comparison group exhibits faster rates of growth than the intervention group for all-cause and ACSC hospitalizations. The intervention group has a slower rate of growth for ACSC ER visits relative to the comparison group during the initial 12 months of analysis and a slower rate of growth for all-cause ER visits during the final 12 months of analyses. However, none of the differences are 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. We found no statistically significant differences in rates of growth in any of the four utilization measures.

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 for both the initial 12 months and last 12 months of analyses. **Table 5-3** displays the percentage of all three populations' beneficiaries with a hospitalization, the percentage 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.

For the Phase I Original population, we mostly observe a pattern of growth in the percentage of beneficiaries with a hospitalization and the rate of readmission for all causes for both the intervention and comparison groups during both time periods of analyses. The ACSC same-cause readmission rates decreased for the intervention group in both time periods while the comparison group saw a decrease in only the first 12 months of analysis. The general pattern of growth in rates indicates that the rate of readmission among the beneficiaries readmitted is growing during the demonstration period likely signaling deterioration in health status. For both time periods, the rate of growth for the intervention group all-cause readmission was slower than for the comparison group. The rate of readmission for ACSCs declined more for beneficiaries in the intervention group than for beneficiaries in the comparison group during the first 12 months of analysis. In the later 12 months of analysis, the rate of readmission declined for intervention group beneficiaries but increased for comparison group beneficiaries. None of the differences in rates of growth are statistically significant; however, the confidence intervals are extremely large rendering sizable D-in-D rates statistically insignificant.

Results for the Phase I Refresh population follow a similar pattern of general growth in the percentage of beneficiaries who are hospitalized and readmitted and the rate of readmission for all-causes and ACSCs during the two analyses periods. The Phase I Refresh intervention population had a slower rate of growth for hospitalizations than the comparison group during both analyses time periods. All but one D-in-D rate are statistically insignificant. The percentage of comparison beneficiaries with an all-cause readmission decreased modestly while the percentage of intervention beneficiaries increased yielding a 14 percentage point D-in-D estimate ($p=0.04$).

A somewhat different pattern emerges within the Phase II population. The percentage of beneficiaries with an all-cause hospitalization declined and the percentage of beneficiaries with an ACSC hospitalization rose in both time periods for both groups. We also observe a pattern of growth in the percentage of beneficiaries with an all-cause readmission and the rate of all-cause readmissions in both time periods and for both groups of beneficiaries. There are no statistically significant differences between the intervention and comparison groups for these measures. In contrast, the rate of ACSC readmission increased within the intervention group and decreased within the comparison group yielding a large and statistically significant D-in-D rate; however, the confidence interval is extremely wide reflecting considerable variability likely from small sample sizes. Only 6% of intervention beneficiaries were admitted during the latter time period of the demonstration.

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

Counts of beneficiaries	Intervention	Comparison
Phase I Original – months 7-18		
Total number of beneficiaries	386	366
Full time equivalents ¹	349	328
Phase I Original – months 20-31		
Total number of beneficiaries	312	289
Full time equivalents ¹	278	256
Phase I Refresh – months 7-18		
Total number of beneficiaries	705	664
Full time equivalents ¹	656	614
Phase I Refresh – months 20-31		
Total number of beneficiaries	605	554
Full time equivalents ¹	544	510
Phase II population – months 7-18		
Total number of beneficiaries	1,995	1,998
Full time equivalents ¹	1,898	1,913
Phase II population – months 20-31		
Total number of beneficiaries	1,811	1,801
Full time equivalents ¹	1,712	1,730

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 2008-2012 Medicare enrollment, eligibility, claims and encounter data; Computer runs: readm01 readmtab readm readmtab readmtab1

Table 5-3
Change in 90-day readmission¹ rates between the year prior to the Phase II Health Buddy[®] West Program CMHCB
Demonstration and months 7-18 and the last 12 months of the demonstration

Utilization	Baseline rate per 1,000 ^{1,2,3}	Baseline rate per 1,000 ^{1,2,3}	Demo period rate per 1,000 ^{1,2,3}	Demo period rate per 1,000 ^{1,2,3}	D-in-D	OR/IRR ⁴	<i>p-value</i>	Low CI	High CI
	I	C	I	C					
Phase I Original									
Months 7-18									
Hospitalizations									
Percent with hospitalization	33	37	38	33	9	1.49	0.07	0.96	2.30
Percent with ACSC hospitalization	19	22	23	22	4	1.29	0.32	0.78	2.15
All-cause 90-day readmission									
Percent with readmission	34	34	37	38	-2	0.93	0.85	0.45	1.94
Readmission rate / 1,000	570	510	649	797	-209	0.73	0.29	0.41	1.31
ACSC same-cause 90-day readmission									
Percent with readmission	15	14	12	13	-2	0.82	0.77	0.22	3.05
Readmission rate / 1,000	222	218	142	202	-65	0.69	0.56	0.20	2.39
Phase I Original									
Months 20-31									
Hospitalizations									
Percent with hospitalization	29	34	34	40	-1	0.96	0.87	0.59	1.57
Percent with ACSC hospitalization	15	18	21	27	-3	0.89	0.70	0.49	1.60
All-cause 90-day readmission									
Percent with readmission	30	28	27	32	-7	0.72	0.47	0.30	1.74
Readmission rate / 1,000	462	390	492	687	-266	0.61	0.21	0.28	1.32
ACSC same-cause 90-day readmission									
Percent with readmission	8	10	7	19	-11	0.38	0.29	0.06	2.33
Readmission rate / 1,000	125	129	121	283	-158	0.44	0.34	0.08	2.39
Phase I Refresh									
Months 7-18									
Hospitalizations									
Percent with hospitalization	28	28	28	33	-4	0.83	0.28	0.59	1.16
Percent with ACSC hospitalization	15	16	17	21	-4	0.79	0.26	0.53	1.19
All-cause 90-day readmission									
Percent with readmission	26	34	38	33	14	1.89	0.04	1.02	3.47
Readmission rate / 1,000	418	471	670	560	163	1.35	0.26	0.80	2.28
ACSC same-cause 90-day readmission									
Percent with readmission	12	20	18	17	8	1.85	0.23	0.67	5.10
Readmission rate / 1,000	194	211	267	256	27	1.13	0.80	0.44	2.92

(continued)

Table 5-3 (continued)
Change in 90-day readmission¹ rates between the year prior to the Phase II Health Buddy[®] West Program CMHCB
Demonstration and months 7-18 and the last 12 months of the demonstration

Utilization	Baseline rate per 1,000 ^{1,2,3}	Baseline rate per 1,000 ^{1,2,3}	Demo period rate per 1,000 ^{1,2,3}	Demo period rate per 1,000 ^{1,2,3}	D-in-D	OR/IRR ⁴	<i>p-value</i>	Low CI	High CI
	I	C	I	C					
Phase I Refresh									
Months 20-31									
Hospitalizations									
Percent with hospitalization	26	26	27	33	-6	0.76	0.16	0.53	1.11
Percent with ACSC hospitalization	14	13	17	19	-3	0.78	0.30	0.49	1.24
All-cause 90-day readmission									
Percent with readmission	22	30	28	34	2	1.12	0.76	0.55	2.27
Readmission rate / 1,000	382	422	571	718	-107	0.88	0.70	0.45	1.70
ACSC same-cause 90-day readmission									
Percent with readmission	11	21	18	20	9	1.99	0.24	0.63	6.30
Readmission rate / 1,000	183	234	308	252	107	1.56	0.43	0.52	4.69
Phase II population									
Months 7-18									
Hospitalizations									
Percent with hospitalization	26	28	25	25	1	1.05	0.62	0.86	1.29
Percent with ACSC hospitalization	9	10	11	11	1	1.11	0.50	0.83	1.48
All-cause 90-day readmission									
Percent with readmission	19	25	26	29	2	1.20	0.39	0.79	1.80
Readmission rate / 1,000	266	375	397	563	-57	1.00	0.98	0.67	1.48
ACSC same-cause 90-day readmission									
Percent with readmission	8	17	9	16	2	1.30	0.56	0.53	3.18
Readmission rate / 1,000	97	268	136	298	9	1.26	0.61	0.52	3.08
Phase II population									
Months 20-31									
Hospitalizations									
Percent with hospitalization	25	27	22	25	-1	0.96	0.70	0.77	1.19
Percent with ACSC hospitalization	8	10	10	13	-1	0.95	0.73	0.69	1.29
All-cause 90-day readmission									
Percent with readmission	16	23	24	25	7	1.55	0.06	0.98	2.47
Readmission rate / 1,000	220	344	416	452	88	1.44	0.11	0.92	2.25
ACSC same-cause 90-day readmission									
Percent with readmission	6	16	10	13	7	2.29	0.11	0.84	6.26
Readmission rate / 1,000	80	281	159	194	166	2.89	0.04	1.04	7.97

(continued)

Table 5-3 (continued)
Change in 90-day readmission¹ rates between the year prior to the Phase II Health Buddy[®] West Program 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 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 Medicare enrollment, eligibility, claims and intervention data; Computer runs: readm01 readm02 readmtab readmtab1

5.3.3 Mortality

Mortality rates for intervention and comparison groups for the three Phase II Health Buddy® West Demonstration cohorts are displayed in **Table 5-4**. Over the Phase II demonstration period, 36% of the Phase I Original beneficiaries died in the intervention group and 39% died in the propensity score adjusted comparison group. Slightly lower percentages of beneficiaries died during the Phase II demonstration period in the Phase I Refresh population (28% and 30% for the intervention and comparison groups, respectively). The percentage of beneficiaries in the Phase II population that died was half of the percentage observed among the Phase I Refresh population. No statistically significant differences in mortality rates for the Phase I populations or Phase II population were observed.

Table 5-4
Mortality rates during the Phase II Health Buddy® West CMHCB Demonstration

Description	Intervention number of deaths	Percent	Comparison number of deaths ¹	Percent	Difference	<i>p-value</i>
Phase I Original population (34 months)	145	36	148	39	-0.03	0.43
Phase I Refresh population (34 months)	205	28	204	30	-0.01	0.58
Phase II population (34 months)	278	14	310	15	-0.02	0.15

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

We further explored the rate 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 ranging from 0.903 to 0.928 with none being 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 continue to observe no survival advantage among intervention beneficiaries in any of the three cohorts.

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

Characteristics	Phase I Original cohort		Phase I Refresh cohort		Phase II cohort	
	Hazard ratio	<i>p-value</i>	Hazard ratio	<i>p-value</i>	Hazard ratio	<i>p-value</i>
Intervention	0.903	0.38	0.928	0.45	0.906	0.23
Age <65	1.118	0.97	1.007	0.42	1.002	0.78
Age 75-84	1.004	0.02	1.007	0.00	1.006	0.00
Age ≥ 85	1.009	0.00	1.014	0.00	1.015	0.00
Charlson Index Score	0.981	0.56	1.024	0.39	1.050	0.04
Baseline PBPM Cost	1.000	0.02	1.000	0.64	1.000	0.01
Baseline HCC score	1.233	0.01	1.246	0.00	1.734	0.00
Medicaid	1.000	0.70	1.000	0.02	1.000	0.01
Disability Original Reason	0.999	0.97	1.000	0.17	1.000	0.55
White	1.001	0.76	1.002	0.45	1.007	0.02
Female	0.997	0.01	0.999	0.56	0.999	0.54
Institutionalized	1.000	0.39	1.000	0.00	1.000	0.02

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

The age reference group is 65-74 years.

Program: Dietab3v2

We further explored the rate of mortality among intervention beneficiaries that used the Health Buddy[®] device and the full comparison group 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 a higher rate of mortality than Health Buddy[®] device users within each of the three cohorts with one difference being statistically significant; 5% of Phase II intervention beneficiaries using the Health Buddy[®] device died during the 34-month demonstration period in contrast to 8% of comparison beneficiaries ($p=0.02$).

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

Description	Health Buddy [®] device	Percent	Comparison Group	Percent	Difference	<i>p-value</i>
Phase I Original population (34 months)						
Number of beneficiaries	89	20.9	86	100	N/A	N/A
Number of deaths	15	16.9	19	22.3	-5.4	0.37
Phase I Refresh population (34 months)						
Number of beneficiaries	177	23.9	167	100	N/A	N/A
Number of deaths	25	14.1	28	16.8	-2.7	0.49
Phase II population (34 months)						
Number of beneficiaries	632	30.5	631	100	N/A	N/A
Number of deaths	31	4.9	52	8.2	-3.3	0.02

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, mortality2.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 0.727 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 0.01 level.

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

Characteristics	Hazard ratio	<i>p-value</i>
Device	0.727	0.01
Phase I Original cohort	2.024	0.00
Phase I Refresh cohort	1.869	0.00
Age <65	1.005	0.65
Age 75-84	1.005	0.00
Age ≥ 85	1.012	0.00
Charlson Index Score	0.996	0.91
Baseline PBPM Cost	1.000	0.86
Baseline HCC score	1.619	0.00
Medicaid	1.000	0.83
Disability Original Reason	1.000	0.31
White	1.005	0.28
Female	0.999	0.54
Institutionalized	1.000	0.23

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

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

Program: Dietab3v3.

5.4 Conclusions

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

- Did the Phase II Health Buddy[®] West Program Demonstration improve intermediate health outcomes by reducing acute hospitalizations, readmissions, and ER utilization?
- Did the Phase II Health Buddy[®] West Program Demonstration improve health outcomes by decreasing mortality?

During the course of the Phase II Health Buddy[®] West Program 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. Across 62 measures of acute care utilization that we examined for the three cohorts and for two time periods within Phase II, we found three statistically significant differences in the rate of growth in acute care utilization in the intended direction and two differences in an unintended direction. The Phase I Refresh population's intervention group exhibited slower growth in all-cause hospitalizations as well as all-cause and ACSC ER visits relative to the comparison group during the last 12 months of the demonstration using a conventional *p-value* of 0.05 or less. In contrast, a higher percentage of the Phase I Refresh intervention beneficiaries were readmitted for all causes during months 7 through 18 of Phase II and Phase II intervention beneficiaries exhibited a higher ACSC readmission rate during months 20-31 of Phase II.

We do not observe a statistically significant differential rate of mortality between the intervention and comparison groups for the three populations. Similarly, 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, we observed no survival benefit for the comparison or intervention groups for all three populations. However, 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, with a hazard ratio of 0.727 ($p=0.01$). This is consistent with the survival benefit we found among the Health Buddy[®] device users in Phase I of the Health Buddy[®] West Program and Phase II of the Health Buddy[®] Program at Montefiore.

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[®] West Program 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 PBPM costs 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[®] West Program 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 Phase II 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[®] West Program 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,
- both base year and demonstration period PBPM costs are weighted by each beneficiary's fraction of eligible days as well as propensity matching scores during the demonstration period, and

- the base year is defined as the 12 months preceding the start of Phase II while ARC continued to use the original 12-month base periods prior to the original and first refresh cohorts starting Phase I.

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

The rest of this chapter has seven 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 cost savings in relation to average monthly fees and whether the Phase II Health Buddy[®] West Program Demonstration achieved budget neutrality using RTI's costing methods. Multivariate regression methods are used to control for any imbalances between intervention and comparison samples that might affect t-tests of mean differences rates in PBPM cost growth. Tests are conducted between the full intervention and comparison groups (**Section 6.6**) as well as between device users and a matched comparison group (**Section 6.7**). The chapter concludes in **Section 6.8** 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[®] West Program Demonstration intervention and comparison groups. Three cohorts were analyzed:

1. The Phase I Original cohort which started on February 1, 2006 and continued through the end of Phase II on January, 2012.
2. The Phase I Refresh cohort that started on February 2, 2007 and continued through the end of Phase II on January, 2012.
3. The Phase II population cohort that started on December 1, 2009 at the beginning of Phase II and continued through the end of Phase II on January, 2012.

Phase II performance in all three cohorts was evaluated from April 1, 2009 through January 31, 2012.

We restricted all analyses to beneficiaries who were alive at the start date of the Phase II demonstration. The base period for all three cohorts was defined as the 12 months preceding the start of Phase II. 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 Health Buddy[®] West Program 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 cost basis, or the ratio of eligible Medicare costs to eligible months with the beneficiary as the unit of analysis. The baseline period for all three cohorts is defined as 365 days (or 1 year) prior to the start of Phase II. The Phase II demonstration period spanned 34 months, or 1,034 days, between April 1, 2009 and January 31, 2012.

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 34 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 Phase II 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 ARC (2013) for financial reconciliation. While a 1% trim reduces the Phase II Health Buddy[®] West Program Demonstration's financial risk, RTI wanted to avoid biasing cost savings against the intervention if it constrained spending among the most expensive beneficiaries.⁴ 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, times his/her propensity score. 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.

⁴ Trimming was done by ARC for both intervention and comparison groups. This sometimes made the intervention savings higher but also sometimes lower.

Because demonstration beneficiaries were not randomly selected, it is possible that material imbalances in their characteristics exist between intervention and comparison groups. RTI corrected for imbalances using a compound weight that includes a propensity score (ps) for each intervention and comparison beneficiary and an eligibility fraction to reflect the length of program eligibility. The ps score was based on a logistic regression using observable characteristics (see **Section 6.3.4**). All intervention beneficiaries were given a ps = 1 with comparison beneficiary costs weighted by ps/(1-ps). A separate set of ps weights were determined for device users compared with all comparison beneficiaries. To avoid extreme weighting, propensity score weights were capped at 5.0, and comparison weights were normalized to 1.0.

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[®] West Program Demonstration negotiated a constant monthly disease management fee of \$132 for all three cohorts (ARC, 2013, Table 3). Monthly fees were paid for all Phase II population beneficiaries during the first 6 months of Phase II outreach. No monthly fees were paid in the last two months of the demonstration for any of the three cohorts of beneficiaries. See **Section 6.3.3** for adjustments to monthly fees when determining budget neutrality.

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[®] West Program 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.⁵ 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

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

compared with 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 not mathematically equivalent to ARC's method that adjusts comparison costs in the demonstration period up or down depending on the ratio of intervention to comparison costs in the base period (6.1b). When base period intervention costs exceed (are less than) comparison costs, RTI cost savings will be greater (less than) ARC savings. 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 times propensity scores 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 by duration of eligibility in the demonstration period. 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. It did not seem reasonable to give beneficiaries with limited exposure in the actual demonstration full credit in calculating mean base year costs

⁵ For a more detailed description of this approach, see Rosner (2006, chapter 8).

even if they had 12 months of base year Medicare eligibility. In addition to “down-weighting” 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.⁶ 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. Power analyses are usually performed in advance of the study to avoid committing a Type II error and reject a true intervention effect. Now that the demonstration is over, we have the information on both the mean and standard error in savings rates at the beneficiary level that allows us to calculate the detectable savings threshold for the Phase II Health Buddy[®] West Program Demonstration.

The fundamental test statistic for detectable savings is the Z-ratio of gross savings (see eq. 6.1a) relative to the standard error (SE) of the difference in growth 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 test⁷ of intervention savings at a 5% level of significance was used with the following confidence interval:

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

This results in a negative detectable threshold, DT, of

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

⁶ 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.

⁷ 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.

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.⁸ It is also convenient for some analyses to express the DT as a percent of the comparison group's demonstration mean PBPM cost, or $DT/PBPM_c = -1.96[SE_{\Delta I-\Delta C}/PBPM_c]$.

Tables 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[®] West Program Demonstration's intervention and comparison groups for all three cohorts. The Phase I Original cohort's base year comparison PBPM costs prior to Phase II, see *Table 6-1*, ranged from \$0 to \$9,346 with a mean cost of \$1,058. Base year intervention costs ranged between \$0 and \$12,960 with a mean of \$1,073. Coefficients of variation of 140 and 147 indicate relatively high cost variance on a PBPM cost basis—even after deleting beneficiaries with less than 3 months of Phase II eligibility. The distribution of costs also shows strong right skewness with median costs about one-half of mean costs. Mean PBPM costs on an unweighted basis nearly double between the base and demonstration periods.

Sample sizes decline markedly for the Phase I intervention group cohorts: 2,025 (Phase II cohort); 725 (Phase I Refresh); 402 (Phase I Original). Declining sample sizes are associated with rising mean and median costs but falling variation in costs. Also, PBPM costs increase faster when cohorts were formed earlier in time. For instance, costs nearly double between base and demonstration period for the Phase I Original cohort compared with a 25-50% increase for the more recent Phase II cohort.

⁸ 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® West Program 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)	(382)	(402)	(382)	(402)
Minimum	\$0	\$0	\$4	\$0
<10%	80	87	180	217
<25%	157	201	461	534
Median	465	460	1,263	1,175
>75%	1,324	1,169	2,797	2,454
>90%	2,887	2,703	5,018	4,672
Maximum	9,346	12,960	16,191	20,734
Mean	1,058	1,073	2,070	1,957
CV	140.19	147.43	117.27	122.36

NOTES: CMHCB = Care Management for High Cost Beneficiaries; PBPM = per beneficiary per month; (N) = number of beneficiaries; CV = coefficient of variation. Observations unweighted.

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

SOURCE: Medicare 2009-2011 Part A & B claims; COSTRUN2 (6/20/13).

Table 6-2
Phase II Health Buddy[®] West Program 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)	(688)	(725)	(688)	(725)
Minimum	\$0	\$0	\$0	\$3
<10%	54	69	109	118
<25%	131	146	294	272
Median	347	357	819	739
>75%	1,033	939	1,997	1,751
>90%	2,708	2,520	3,561	3,333
Maximum	13,970	10,518	19,115	20,633
Mean	946	867	1,556	1,404
CV	160.07	156.26	142.14	141.92

NOTES: CMHCB = Care Management for High Cost Beneficiaries; PBPM = per beneficiary per month; (N) = number of beneficiaries; CV = coefficient of variation. Observations unweighted.

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

SOURCE: Medicare 2009-2011 Part A & B claims; COSTRUN2 (6/20/13).

Table 6-3
Phase II Health Buddy® West Program 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)	(2,024)	(2,025)	(2,024)	(2,025)
Minimum	\$0	\$0	\$0	\$0
<10%	52	60	84	87
<25%	116	131	188	188
Median	266	303	513	516
>75%	847	890	1,313	1,253
>90%	2,066	2,113	2,908	2,567
Maximum	15,357	16,491	48,518	28,790
Mean	804	814	1,214	1,080
CV	172.70	174.42	194.97	165.03

NOTES: CMHCB = Care Management for High Cost Beneficiaries; PBPM = per beneficiary per month; (N) = number of beneficiaries; CV = coefficient of variation. Observations unweighted.

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

SOURCE: Medicare 2009-2011 Part A & B claims; COSTRUN2 (6/20/13).

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 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 were higher in the intervention group's base period relative to the comparison group, i.e., $\alpha_j > 1.0$, then CMS adjusted comparison costs ($PBPM_c$) upwards in the demonstration period to account for the discrepancy. As long as adjusted comparison costs exceed intervention mean costs ($PBPM_I$), gross savings are positive. Three scenarios capture the three possible financial settlements at the end of the demonstration:

$$\text{Full Payback: } GS_j^* \leq \theta_j PBPM_c \quad (6.7)$$

$$\text{Partial Fee Payback: } \theta_j \text{PBPM}_c < \text{GS}_j^* < \text{MF}_j + \theta_j \text{PBPM}_c \quad (6.8)$$

$$\text{Retain all Fees: } \text{GS}_j^* \Rightarrow \theta_j \text{PBPM}_c + \text{MF}_j. \quad (6.9)$$

When adjusted gross savings per beneficiary are less than the minimum required percentage θ_j of comparison group costs, the CMO must return all fees paid out, i.e., Full Payback. CMS' minimum required percentages for the Health Buddy[®] West Program 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 CMO must pay back the shortfall. Finally, the CMO 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 net savings figure. This approach effectively weights the nominal monthly fee (i.e., \$132) by the ratio of fee-bearing to intervention total eligible months and is called the adjusted monthly fee. 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 ARC's 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 produced an estimate of *net savings* per beneficiary by debiting the adjusted monthly fee from the estimated gross savings. Finally, a CMS return on investment in fees was determined as the ratio of gross savings per beneficiary to the adjusted monthly fee.

A potential drawback of the difference-in-differences method is that it does not control for baseline differences in beneficiary characteristics except for costs. Group differences in age and Medicaid eligibility, for example, may result in different rates of growth in Medicare costs. The method also does not provide a robust estimate of the savings that may have accrued specifically to intervention beneficiaries using the Health Buddy[®] device. In the next section, we show how balanced, or similar, the comparison groups were to each of the three intervention cohorts.

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

Because the Phase II Health Buddy[®] West Program 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[®] West Program 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.

It should be kept in mind that for differences in other beneficiary characteristics to have any material effect on intervention savings, two conditions must be present. First, one or more characteristics must have a statistically important effect on PBPM cost *growth rates*, not just on demonstration period 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.

RTI’s selection of comparison beneficiaries began with the selection of a set of counties similar to the intervention counties. Propensity score matching was then used to weight the performance of each comparison group beneficiary. Beneficiaries with characteristics more typical of intervention beneficiaries were given greater weight than those that were less similar to intervention beneficiaries.

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. Device users in column three are weighted by their eligibility fraction.

Intervention beneficiaries, compared with comparison beneficiaries, are closely matched on all variables. Device users, compared with the comparison group after reweighting, are less likely to be under age 65 or disabled, and more likely to be between the ages of 65 and 69. Device users are less likely to be eligible for Medicaid but more than three times more likely to have been in a Skilled Nursing Facility prior to Phase II than beneficiaries in the comparison group. How these differences affect cost savings from the intervention will depend upon how each characteristic difference affects the *change* in costs.

Table 6-4
Phase II Health Buddy® West Program 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	5.4	5.8	3.5
65-69	7.0	6.8	10.7
70-74	21.7	21.2	19.0
75-79	26.3	25.0	24.9
80-84	24.1	24.5	27.2
85+	15.5	16.7	14.8
Gender			
Female	49.2	48.5	49.3
Male	50.8	51.5	50.7
Race			
Minority	3.7	3.7	2.2
White	96.3	96.3	97.8
Medicaid Eligible			
No	80.2	81.2	85.8
Yes	19.8	18.8	14.2
Disabled			
No	94.0	93.6	95.2
Yes	6.0	6.4	4.8
Long-term care			
No	100.0	100.0	99.1
Yes	0.0	0.0	0.9
Skilled Nursing Facility			
No	93.6	91.9	71.5
Yes	6.4	8.1	28.5
HCC Score Mean	1.85	1.83	1.84
Charlson Score Mean	3.46	3.47	3.37

NOTE: CMHCB = Care Management for High Cost Beneficiaries; HCC = Hierarchical Condition Category. Beneficiaries weighted by fraction of eligible days in demonstration period times each beneficiary's propensity score. Intervention group includes device users and non-users.

SOURCE: Medicare 2009-2011 Part A & B claims; Cost4b1a (6/25/13).

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 closely matched on all characteristics after reweighting. Device users were less likely to have Medicaid coverage and more likely to have been in a Skilled Nursing Facility compared with the comparison group.

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 even for Medicaid eligibility. Health Buddy[®] device users are also quite similar to the comparison group except that they were more than twice as likely to have been in a Skilled Nursing Facility prior to the start of Phase II.

RTI's second approach to imbalances used multivariate regressions to adjust for the effects of any remaining imbalances, after reweighting, on trends in PBPM costs. We pooled base and demonstration period observations 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):

$$PBPM_{pt} = \alpha + \gamma PBPM_{pb} + \beta Status + \sum_j \rho_j Cht_j + \sum_k \lambda_k PChar_{pk} + \varepsilon_{pt}. \quad (6.10)$$

The cohort indicators were used only in separate tests of gross savings for device users. Three separate regressions were run for the three cohorts when comparing all intervention to comparison beneficiaries.

The intercept, α , is the Phase I Original comparison group's average PBPM cost in the base year, while γ is the average fractional contribution to demonstration period costs of a \$1 higher base period cost; hence, 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).

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. Due to the relatively small number of device users, beneficiaries across all three cohorts were pooled to produce an overall estimate of device cost savings. Two cohort indicators were included to adjust for possible differences in cost savings due to the beneficiary's cohort. Including PChar in the model further controls for any initial imbalances.

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

Characteristic	Intervention (%)	Comparison (%)	Device (%)
Age Group			
<65	7.4	7.1	6.3
65-69	9.1	10.0	9.7
70-74	21.6	22.7	21.8
75-79	20.9	21.9	22.6
80-84	20.7	18.7	22.6
85+	20.3	19.6	16.9
Gender			
Female	46.8	44.5	47.5
Male	53.2	55.6	52.5
Race			
Minority	3.6	3.7	2.9
White	96.4	96.3	97.1
Medicaid Eligible			
No	81.5	82.6	90.1
Yes	18.5	17.4	9.9
Disabled			
No	92.3	92.5	92.4
Yes	7.7	7.5	7.6
Long-term care			
No	100.0	100.0	100.0
Yes	0.0	0.0	0.0
Skilled Nursing Facility			
No	94.5	95.5	85.1
Yes	5.5	4.5	14.9
HCC Score Mean	1.54	1.57	1.43
Charlson Score Mean	2.97	3.01	3.14

NOTE: CMHCB = Care Management for High Cost Beneficiaries; HCC = Hierarchical Condition Category. Beneficiaries weighted by fraction of eligible days in demonstration period times each beneficiary's propensity score. Intervention group includes device users and non-users.

SOURCE: Medicare 2009-2011 Part A & B claims; Cost4b1a (6/25/13).

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

Characteristic	Intervention (%)	Comparison (%)	Device (%)
Age Group			
<65	6.8	6.9	6.9
65-69	17.8	18.4	20.7
70-74	25.0	24.1	26.1
75-79	20.5	22.2	20.1
80-84	16.6	15.0	15.8
85+	13.3	13.4	10.4
Gender			
Female	42.6	43.2	42.0
Male	57.4	56.8	58.0
Race			
Minority	2.8	3.0	2.6
White	97.2	97.0	97.4
Medicaid Eligible			
No	87.5	86.6	87.7
Yes	12.5	13.4	12.3
Disabled			
No	93.0	92.9	92.9
Yes	7.0	7.1	7.1
Long-term care			
No	100.0	100.0	100.0
Yes	0.0	0.0	0.0
Skilled Nursing Facility			
No	96.0	95.7	90.3
Yes	4.0	4.3	9.7
HCC Score Mean	1.19	1.22	1.15
Charlson Score Mean	2.12	2.16	2.20

NOTE: CMHCB = Care Management for High Cost Beneficiaries; HCC = Hierarchical Condition Category. Beneficiaries weighted by fraction of eligible days in demonstration period times each beneficiary's propensity score. Intervention group includes device users and non-users.

SOURCE: Medicare 2009-2011 Part A & B claims; Cost4b1a (6/25/13).

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 34-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 also 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.

All Intervention Beneficiaries. The eligibility-weighted base year average PBPM cost was \$36 more (3.8%) ($p=\text{insig}$) in the intervention versus the comparison group (\$977 versus \$942). The intervention-comparison difference in PBPM Medicare costs decreased slightly to \$16 ($p=\text{insig}$) in the demonstration period (\$1,575 versus \$1,560). Intervention beneficiaries remained 1% more costly, on average, than the comparison group.

Between the mid-points of the base year and the 34-month demonstration period, average comparison group PBPM costs increased significantly by \$618 ($p<0.01$), or by nearly two-thirds, while the intervention group's PBPM average Medicare costs rose by \$598 ($p<0.01$). Consequently, the intervention group's PBPM cost rose \$20 slower ($p=\text{insig}$) than the comparison group's PBPM cost.

Participation Status. The participation rate, based on beneficiaries used in this cost analysis, was 35% (142/402). Participant costs in the Phase II Health Buddy[®] West Program Demonstration intervention group were 20% higher (\$188; $p=\text{insig}$) than in the comparison group in the base period. Non-participants were 6% (\$53) less costly ($p=\text{insig}$). Participant costs rose \$102 faster ($p=\text{insig}$) relative to comparison costs over the demonstration period while non-participant costs grew \$91 ($p=\text{insig}$) slower relative to the comparison group. Thus, the \$20 slower growth in intervention PBPM costs over the demonstration period appears to be due entirely to slower growth in the non-participant group.

Table 6-7
Phase II Health Buddy® West Program 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	402	\$977	72.9	\$1,575	89.8	\$598**	100.6
Participants ²	142	1,129	152.4	1,849	173.5	720**	207.6
Nonparticipants	260	889	74.6	1,415	99.6	527**	105.1
Comparison	382	942	67.9	1,560	92.4	618**	100.1
<u>Differences</u>							
I – C	—	36	99.9	16	128.9	-20	142
Participants - C	—	188	143.7	290	182.7	102	205.1
Nonparticipants - C	—	-53	102.9	-144	139.1	-91	149.3
Participants - Nonparticipants	—	241	150.8	434*	185	193	208.5

NOTES: CMHCB = Care Management for High Cost Beneficiaries; 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 HB device.

Statistical tests for differences: * $p < 0.05$; ** $p < 0.01$.

SOURCE: Medicare 2009-2011 Part A&B claims; costrun1a (6/20/13).

6.4.2 Phase I Refresh Cohort

All Intervention Beneficiaries. *Table 6-8* displays PBPM cost levels and rates of growth in average PBPM costs between the base year and the end of the 34-month demonstration period for the Phase I Refresh cohort. The weighted base year average PBPM cost was \$16 less ($p=\text{insig}$) in the intervention versus comparison group (\$818 versus \$834). The intervention-comparison gap in PBPM costs widened to -\$87 ($p=\text{insig}$) in the demonstration period (\$1,151 versus \$1,238).

The average comparison group PBPM cost increased 48% (\$404; $p<0.01$) while the intervention group's PBPM cost increased 41% (\$333; $p<0.01$). As a result, the intervention group's PBPM cost grew \$71 slower ($p=\text{insig}$) relative to the comparison group's. Intervention beneficiaries, who were 2% 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 36% (260/725). Intervention participants were \$27 less costly ($p=\text{insig}$) than comparison beneficiaries and non-participants were \$10 less costly ($p=\text{insig}$). Participants became \$22 more costly ($p=\text{insig}$) during the demonstration period. Non-participants became -\$151 less costly ($p<0.10$) during the demonstration period. Consequently, the participant group's PBPM cost rose \$48 faster ($p=\text{insig}$) than the comparison group's cost while the non-participant group's PBPM cost rose \$141 slower ($p=\text{insig}$) than the comparison group's PBPM cost. Thus, the -\$71 in gross savings in the Phase I Refresh cohort appears to be due to slower cost growth among non-participants in the intervention group.

Table 6-8
Phase II Health Buddy® West Program 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 PBPM SE	Demo PBPM Mean ¹	Demo PBPM SE	Differences in means	SE
Intervention	725	\$818	49.5	\$1,151	59.4	\$333**	64.8
Participants ²	260	807	79.7	1,260	113.5	452**	114
Nonparticipants	465	824	63	1,087	67	263**	78.2
Comparison	688	834	50.6	1,238	59	404**	68.6
<u>Differences</u>							
I – C	—	-16	70.7	-87	83.8	-71	94.2
Participants - C	—	-27	95	22	117.7	48	130.6
Nonparticipants - C	—	-10	80.5	-151	90.5	-141	105.4
Participants - Nonparticipants	—	-17	102.5	173	122.9	189	134.2

NOTES: CMHCB = Care Management for High Cost Beneficiaries; 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 HB device.

Statistical tests for differences: * $p < 0.05$; ** $p < 0.01$.

SOURCE: Medicare 2009-2011 Part A&B claims; costrun1a (6/20/13).

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 (\$774 and \$788). Comparison group PBPM costs increased \$147 ($p<0.01$) while intervention group costs increased \$119 ($p<0.01$). As a result, the intervention group's PBPM cost increased \$27 slower ($p=\text{insig}$) than in the comparison group.

Participation Status. The participation rate for the Phase II cohort was 35% (720/2,025). Participants in the base period in the Phase II Health Buddy[®] West Program Demonstration intervention group were \$25 more costly ($p=\text{insig}$) than comparison group beneficiaries and non-participants were \$38 less costly ($p=\text{insig}$). The participant group's PBPM cost rose \$19 slower ($p=\text{insig}$) than the comparison group's cost while the non-participant group's PBPM cost rose \$32 slower ($p=\text{insig}$) than the comparison group's PBPM cost. Thus, the -\$27 in gross savings in the Phase II cohort appears to be driven more so by slower cost growth among non-participants.

6.5 Savings and Budget Neutrality

6.5.1 Phase I Original Cohort

Table 6-10 presents summary statistics on gross and net savings from the Phase II Health Buddy[®] West Program Demonstration. 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[®] West Program Demonstration's monthly fee is also reported as a percentage of the comparison group's PBPM cost.

Over the course of the 34-month intervention, average monthly costs increased \$20 slower in the Phase I Original intervention cohort. This difference implies gross savings at a rate of 1.3% of the comparison group's demonstration period PBPM cost. These savings were statistically insignificant.

The minimally detectable savings threshold was \$278 using a two-sided 5% confidence level. This threshold level was 18% of the comparison group's PBPM cost of \$1,560. Due to the small remaining number of Phase I Original beneficiaries, the intervention would have had to achieve a rate of savings of 18% to be considered statistically reliable in repeated samples.⁹ The Phase II Health Buddy[®] West Program Demonstration's average monthly fee was \$132 which amounted to 8.5% of the comparison group's PBPM cost. However, fees were paid only on 28% of intervention eligible months, thereby producing an adjusted fee of \$37 per intervention beneficiary-month. The Phase I Original cohort would have had to achieve 7.4% (5% + 2.4%) savings in order to retain all fees according to RTI's calculations, which are not official under financial reconciliation.

⁹ A one-sided 5% test would require 15% savings.

Table 6-9
Phase II Health Buddy[®] West Program 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 PBPM SE	Demo PBPM Mean ¹	Demo PBPM SE	Differences in means	SE
Intervention	2,025	\$774	30.6	\$893	89.6	\$119**	36.6
Participants ²	720	813	38.3	941	45.7	127*	58.6
Nonparticipants	1,305	750	50.9	865	35.7	114*	46.7
Comparison	2,024	788	31.2	934	103.7	147**	41.3
<u>Differences</u>							
I – C	—	-14	43.7	-42	44.4	-27	55.2
Participants - C	—	25	60	6	63	-19	77
Nonparticipants - C	—	-38	49.7	-70	51.6	-32	63.9
Participants - Nonparticipants	—	63	63.4	76	58.4	13	75.8

NOTES: CMHCB = Care Management for High Cost Beneficiaries; 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 HB device.

Statistical tests for differences: * $p < 0.05$; ** $p < 0.01$.

SOURCE: Medicare 2009-2011 Part A&B claims; costrun1a (6/20/13).

Table 6-10
Phase II Health Buddy® West Program CMHCB Demonstration average PBPM gross savings, fees, and budget neutrality status: Three cohorts

Description	PBPM cost change		
	Phase I Original Cohort	Phase I Refresh Cohort	Phase II population Cohort
Intervention group	\$598	\$333	\$119
Comparison group	\$618	\$404	\$147
Gross (dis)-savings PBPM	\$20	\$71	\$27
Gross (dis)saving % ¹	1.3%	5.7%	2.9%
Minimal Detectable Savings ²			
Dollar amount	\$278	\$185	\$108
% of comparison PBPM cost ³	18.0%	15.0%	12.0%
Monthly Fee			
Average dollar amount	\$132	\$132	\$132
Fee-bearing adjusted dollar amount ⁴	\$37	\$37	\$56
% of fee-bearing comparison PBPM cost ⁴	2.4%	3.0%	6.0%
Net Fee (Adjusted)			
Dollar amount ⁵	\$17	-\$34	\$29
% of comparison PBPM cost ³	1.1%	-2.7%	3.1%
Return on Investment (RoI) ⁶	0.54	1.92	0.48

NOTES: CMHCB = Care Management for High Cost Beneficiaries; PBPM = per beneficiary per month.

¹ Gross (Dis)Savings % = Difference in PBPM cost changes as % of comparison demonstration PBPM (\$1,560, Phase I Original cohort; \$1,238, Phase I Refresh cohort; \$934, Phase II population cohort). Negative values imply dis-savings. Savings based on cost differences weighted by beneficiary-specific eligibility fraction 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 in demonstration period.

⁴ Average monthly fee (\$132) reduced by ratio of fee-bearing to intervention total eligible months. Total eligible months based on ARC's Final Reconciliation Report (January 24, 2013; Tables 2 & 3).

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 Tables 6-7, -8, -9; monthly fees based on ARC Final Reconciliation for Health Buddy West Phase 2, June 14, 2012, Tables 3.

If one accepted Phase II Health Buddy[®] West Program Demonstration's intervention savings of \$20, then the net fee to Medicare per fee-bearing intervention beneficiary would be \$17 instead of \$37. Medicare's rate of return on investment would be 0.54, implying a return in savings of \$0.54 for every \$1 invested in the intervention.

6.5.2 Phase I First Refresh Cohort

Table 6-10, column 2, presents summary statistics on gross savings for the Phase I Refresh cohort. Over the course of the 34-month intervention, average monthly costs increased \$333 in the intervention group and \$404 in the comparison group. The result was a \$71 relative decrease in PBPM costs in the intervention group. This level of savings is at a rate of 5.7% of the comparison group's PBPM cost.

With less than 750 beneficiaries each in the intervention and comparison groups, the minimally detectable savings threshold was \$185 at the 5% 2-sided confidence level. This rate is 15% 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. The adjusted monthly fee for this cohort was \$37, or 3% of the comparison group's PBPM cost. The intervention would have had to achieve 5.5% (2.5% + 3%) savings to avoid paying back any fees according to RTI's calculations. Debiting the \$71 in gross savings produced a net fee of -\$34 and a Medicare's return on investment of 1.92. Again ignoring the minimum savings requirement of 2.5%, Medicare saved \$1.92 in outlays on health services for every \$1 in fees it invested in this cohort.

6.5.3 Phase II Second Refresh Cohort

Table 6-10, column 3, presents summary statistics on gross savings for the Phase II cohort. Over the course of the 34-month intervention period, average monthly costs increased \$119 in the intervention group and \$147 in the comparison group. The result was a \$27 slower relative increase in PBPM costs in the intervention group. This difference implies gross savings at a rate of 2.9% of the comparison group's PBPM cost.

With over 2,000 beneficiaries each in the intervention or comparison group, the minimal detectable savings threshold was \$108 at the 5% 2-sided confidence level. This rate is 12% 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. The monthly fee, adjusted by the participation rate, was \$56. After subtracting \$27 in PBPM gross savings, the net fee to Medicare was \$29, or 3% of the comparison group's average monthly PBPM cost. Medicare's return on investment was 0.48. The Medicare program experienced only \$0.48 in savings on health outlays for every \$1 invested in this cohort.

6.6 Multivariate Regression Tests of Intervention Gross Savings

Table 6-11 presents weighted least squares regression results for the Phase I Original, Phase I Refresh, and Phase II cohorts. All intervention and comparison beneficiaries meeting the eligibility criteria are included. Beneficiaries with less than 3 months of Phase II eligibility are excluded. Observation weights are based on the product of beneficiary demonstration period eligibility fractions and intervention-matched propensity scores.

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. Besides propensity score weights, several beneficiary demographic characteristics are included, along with Medicaid dual eligibility, base period long-term and SNF use, and HCC and Charlson severity scores. The intercept reference group for each cohort includes the white, female comparison population, under age 65, non-Medicaid, with no long-term hospital or SNF use in the base year. *P-values* show statistical confidence in the regression estimates.

Phase I Original Cohort. The Phase I Original cohort model had 783 observations and explained 9% (R^2) of the change in beneficiary costs between base and demonstration periods. The baseline PBPM cost estimate of 0.18 implies strong regression-to-the-mean across beneficiaries. Controlling for other variables in the model, and adjusting (through weighting) for any differences in eligibility lengths and sampling differences, the change in intervention mean costs was \$2.15, implying a slightly higher increase in costs relative to the comparison group. This difference was not significant from zero at conventional confidence levels ($p=0.99$).

With so few beneficiaries remaining in this cohort, few regression coefficients are statistically significant in explaining differences in cost increases (as opposed to simple differences in costs) among beneficiaries. Besides each beneficiary's baseline cost, a one unit increase in HCC score added \$266, on average, to the change in costs between the base and demonstration periods.

Phase I Refresh Cohort. The Phase I Refresh cohort model had 1,412 observations and explained 9% of the change in beneficiary costs between the base and demonstration periods. Strong regression-to-the-mean effects are exhibited by the 0.24 coefficient for baseline PBPM costs. Controlling for other variables, the change in intervention mean costs was -\$77.14, implying a lower rate of increase in costs relative to the comparison group. Although quite similar to the savings estimate shown in **Table 6-8** above, this estimate of gross savings was not statistically significant at conventional levels ($p=0.34$). The beneficiary's HCC score at baseline was a strong predictor of cost increases. Every one unit increase in HCC score resulted in an added \$214 in cost increases, on average, over baseline costs.

Table 6-11
Phase II Health Buddy[®] West Program CMHCB Demonstration regression results, all
intervention versus comparison group beneficiaries, Three cohorts

Independent Variable	Phase I Original Cohort		Phase I Refresh Cohort		Phase II Cohort	
	PBPM Demo Coefficient	<i>p-value</i>	PBPM Demo Coefficient	<i>p-value</i>	PBPM Demo Coefficient	<i>p-value</i>
Intercept	1,093.22	0.00	682.65	<0.0001	338.32	<0.0001
Intervention	2.15	0.99	-77.14	0.34	-26.78	0.53
Baseline PBPM Cost	0.18	0.01	0.24	<0.0001	0.07	0.00
Male	4.46	0.97	-57.72	0.48	-27.56	0.53
Minority	-134.10	0.69	-348.35	0.11	44.64	0.73
Age						
70-74	-202.46	0.48	-123.63	0.43	8.40	0.90
75-79	-245.10	0.38	-62.28	0.69	14.87	0.83
80-84	-462.25	0.10	7.07	0.97	11.41	0.88
85+	-274.08	0.35	-178.13	0.28	56.05	0.48
Medicaid	0.00	0.81	0.02	0.10	0.01	0.09
Disabled	-0.05	0.18	0.00	0.90	0.01	0.40
Long-term Care	0.00	—	0.00	—	-555.44	0.73
Skilled Nursing Facility	-40.55	0.90	-344.40	0.12	-64.91	0.60
HCC Score	266.10	0.01	213.55	0.00	310.94	<0.0001
Charlson Score	30.02	0.44	16.52	0.49	51.89	0.00
R ²	0.09		0.09		0.09	
N	783		1,412		4,048	

NOTES: CMHCB = Care Management for High Cost Beneficiaries; PBPM = per beneficiary per month; N = number of beneficiaries. Dependent Variable: Beneficiary's demonstration period PBPM cost. Long-term care, skilled nursing facility = 1 if beneficiary had payments for either type of service in base year. Comparison propensity scores matched to entire intervention group by cohort. Intervention and comparison observations weighted by product of eligibility fraction and beneficiary's propensity score.

The population reference group is the comparison population, the gender reference group is female, the race/ethnicity reference group is white, and the age reference group is 65-69 years of age (beneficiaries less than 65 years of age are categorized as disabled).

SOURCE: Medicare 2009-2011 Part A&B claims. Cost4b3v1 (7/2/13).

Phase II Cohort. The Phase II cohort, having only been formed at the start of Phase II, had by far the largest number of observations (N= 4,048). As with the other cohorts, this cohort showed very strong regression-to-the-mean effects, as evidenced by a baseline PBPM cost coefficient of 0.07 ($p<0.01$). Controlling for other variables, the change in intervention mean costs was -\$26.78, implying a lower rate of increase in costs relative to the comparison group. While similar to the estimate of gross savings shown in *Table 6-9*, this regression-based estimate of savings was not statistically significant at conventional levels. As for the other cohorts, the beneficiary's baseline HCC score was a strong predictor of faster cost increases. A beneficiary with an HCC score one unit above the average exhibited a larger (\$311) increase in costs.

6.7 Multivariate Regression Tests of Health Buddy[®] Device User Gross Savings

Table 6-12 presents weighted least squares regression results for those beneficiaries using the Health Buddy[®] device. Due to the relatively small numbers of beneficiaries using the device, all device users and comparison beneficiaries meeting the eligibility criteria in any of the three cohorts are included. Beneficiaries with less than 3 months of Phase II eligibility are excluded. Observation weights are based on the product of beneficiary demonstration period eligibility fractions and intervention-matched propensity scores. Propensity scores for the comparison group are matched against just users of the Health Buddy[®] device and not all intervention beneficiaries.

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. The pooled model had 3,991 observations. The model explained 11% of the change in beneficiary costs. The base period PBPM cost estimate of 0.15 implies considerable regression-to-the-mean in costs 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 the results found in the Differences-in-Means columns in *Tables 6-7, 6-8, and 6-9*.

Controlling for other variables in the model, and adjusting (through weighting) for any differences in eligibility duration and sampling differences, the Health Buddy[®] device user change in mean costs was \$87.87 lower than the corresponding comparison change in costs. This difference was not significant ($p=0.14$) from zero at conventional levels.

Beneficiaries with SNF use in the base period showed statistically higher 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.

Table 6-12
Phase II Health Buddy® West Program CMHCB Demonstration regression results,
intervention device users versus comparison group beneficiaries

Independent Variable	PBPM Demo Coefficient	<i>p-value</i>
Intercept	307.11	0.00
Device Users	-87.87	0.14
Phase I Original Cohort	449.38	<0.0001
Phase I Refresh Cohort	155.58	0.05
Baseline PBPM Cost	0.15	<0.0001
Male	-0.11	1.00
Minority	-155.63	0.42
Age		
70-74	33.65	0.73
75-79	78.02	0.43
80-84	55.97	0.60
85+	94.41	0.42
Medicaid	0.01	0.48
Disabled	0.00	0.98
Long-term Care	-2,639.59	0.45
Skilled Nursing Facility	504.42	0.00
HCC Score	371.76	<0.0001
Charlson Score	51.53	0.01
R ²	0.11	
N	3,991	

NOTES: CMHCB = Care Management for High Cost Beneficiaries; PBPM = per beneficiary per month; N = number of beneficiaries. Dependent Variable: Beneficiary's demonstration period PBPM cost. Long-term care, skilled nursing facility = 1 if beneficiary had payments for either type of service in base year. Comparison propensity scores matched only to Health Buddy® device users. Intervention and comparison observations weighted by product of eligibility fraction and beneficiary's propensity score.

The population reference group is the comparison population, the gender reference group is female, the race/ethnicity reference group is white, and the age reference group is 65-69 years of age (beneficiaries less than 65 years of age are categorized as disabled).

SOURCE: Medicare 2009-2011 Part A&B claims. Cost5devicev1 (7/2/13).

6.8 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 402 Phase I Original and 725 Phase I Refresh beneficiaries in the intervention group, we had limited power to detect significant savings. Gross savings had to be 18% in the Phase I Original population and 15% in the Phase I Refresh cohort to be considered significant at the 5% level using a 2-sided confidence level. The Phase II cohort, by contrast, had much larger samples: 2,025 intervention and 2,024 comparison beneficiaries. Even still, gross savings had to be in excess of 12% of comparison PBPM costs to be statistically significant.

Based on RTI's methods, gross savings from the Phase II Health Buddy[®] West Program Demonstration intervention did not approach minimally required savings. Costs rose \$20 slower in the Phase I Original intervention group, and Medicare's return on investment was 0.54, implying only \$0.54 in savings for every dollar invested in fees. Costs increased \$71 slower in the Phase I Refresh intervention group, resulting in a favorable return on investment of \$1.92 for every \$1 invested in fees. Intervention cohort costs increased \$27 slower in the larger Phase II cohort yielding only \$0.48 in savings for every dollar invested in fees. None of the increases were statistically significant from zero.

The Phase II Health Buddy West Program Demonstration's negotiated monthly case management fee was \$132 which ranged from 8.5% to 14.1% of the comparison group's PBPM cost depending on cohort. But because of relatively low participation rates, gross savings of only 2.4-6.0% 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, gross savings still would have been statistically insignificant even when adding in the minimum savings thresholds. This is because of the wide variation in beneficiary average monthly costs and relatively small sample sizes. This is true even after excluding beneficiaries with very high costs and less than 3 months of exposure to the intervention.

Multivariate analysis estimated cost savings for each cohort as well as for a small 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.

RTI & ARC Estimates of Gross Savings. ARC, as financial reconciliator for Health Buddy[®] West's Demonstration, estimated total gross savings at \$7,481,753. Using ARC's estimates of eligible member months to weight RTI's estimates of PBPM gross savings, RTI's total gross savings is \$3,369,545, a difference of \$4,112,207. ARC estimated gross savings of \$1.82 million for the Phase I Original cohort; RTI's estimate is \$219,020. ARC's gross savings estimate was decreased by about \$65,000 by trimming outliers and increased by \$2.2 million by the 1.125 baseline adjustment factor which was determined at the start of Phase I and not Phase II (as was RTI's baseline). ARC's gross savings estimate was \$3,111,366 for the Phase I Refresh cohort; RTI's estimated gross savings for this cohort was \$1,473,960. ARC made a \$360,000 outlier trim favorable to this intervention cohort that RTI did not make. ARC also made a favorable \$406,000 adjustment for the base period difference in PBPM costs. RTI

actually had a weighted base year PBPM cost of intervention beneficiaries that was 2% lower after reweighting the comparison group. ARC's estimated gross savings of \$2,549,394 for the Phase II cohort; RTI's gross savings for this cohort was \$1,676,565. ARC made a favorable outlier trim of \$970,000 for this cohort along with a favorable baseline adjustment of \$60,000.

The largest share of the difference in the ARC and RTI estimates is in the way the baseline adjustment was made. In continuing to use the original base year cost differences, ARC's method produced a favorable adjustment of about \$2.2 million. RTI's base year adjustments (a) downweighted base year PBPM costs for short durations of eligibility during Phase II, (b) deleted base year cases with less than 3 months of Phase II eligibility, and (c) downweighted base year costs for comparison beneficiaries who were unlike the typical intervention beneficiary at the start of Phase II (e.g., younger). ARC's approach also considered the two Phase I cohorts as continuing into Phase II while RTI considered Phase II as an entirely separate "demonstration" with new baselines. ARC's favorable outlier trims amounting to over one million dollars also contributed significantly to its gross savings estimate that was more than double RTI's estimate.

CHAPTER 7

KEY FINDINGS FROM THE PHASE II HEALTH BUDDY[®] WEST'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[®] West Care Management for High Cost Beneficiaries (CMHCB) Demonstration program. Our evaluation focuses upon three broad domains of inquiry:

- **Implementation.** To what extent was the Health Buddy[®] West CMHCB Demonstration program able to implement its program?
- **Reach.** How well did the Health Buddy[®] West CMHCB Demonstration program engage its intended audience?
- **Effectiveness.** To what degree was the Health Buddy[®] West CMHCB Demonstration program able to improve beneficiary and provider satisfaction, improve functioning and health behaviors, 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 use 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 from the Phase II evaluation. Our findings are based on the experience of approximately 6,248 ill Medicare 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. Six 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 disease management or care coordination efforts among Medicare fee-for-service (FFS) beneficiaries. The CMHCB demonstration program holds the HBC financially responsible for financial savings but does not hold the HBC financially responsible for quality of care improvements.

Key Finding #1: We observe a lower rate of mortality among intervention beneficiaries but only for those 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 populations. However, 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, with a hazard ratio of 0.727 ($p=0.01$). This is consistent with the survival benefit

we found among the Health Buddy[®] device users in Phase I of the Health Buddy[®] West Program and Phase II of the Health Buddy[®] Program at Montefiore.

Key Finding #2: There were no strong predictors for long-term participation in the Health Buddy[®] West CMHCB Demonstration program.

Across the three cohorts of beneficiaries participating in Phase II, roughly one-third of all eligible beneficiaries agreed to participate: Phase I Original cohort, 35%; Phase I Refresh cohort, 36%; and Phase II cohort, 36%. From our multivariate regression model of participation, we found few indicators predicting long-term participation. Within the Phase I Original population, there were no statistically significant indicators of participation and among the Phase II Refresh population, beneficiaries age 85 and older were less likely to participate, but this result lost significance after controlling for baseline characteristics and demonstration period utilization. For the Phase II population, we found that Medicare beneficiaries age 85 and older during the Phase II demonstration period were less likely to be long-term participants. At the same time, we observed that beneficiaries who were predicted to be the most costly during the year prior to the start of Phase II were more likely to be long-term participants.

Key Finding #3: Less than one-third of the intervention population agreed to use the Health Buddy[®] device.

A cornerstone of the HBC's program was the Health Buddy[®] device and interactions with care managers; however, less than one-quarter of the Phase II Health Buddy[®] West Program Demonstration Phase I Original and Refresh eligible intervention beneficiaries used the Health Buddy[®] device during the Phase II demonstration period, and only one-third of the Phase II population eligible beneficiaries used the device at some point during the Phase II intervention period. Under an intent-to-treat model, active engagement of roughly one-third of the total number of intervention beneficiaries requires that the HBC program has a large intervention effect on the beneficiaries with whom the HBC program staff members are actively engaging to achieve the desired outcomes.

Among the beneficiaries that did agree to participate in the HBC program, use of the Health Buddy[®] device was high (80%). Of the beneficiaries participating in the program and using the Health Buddy[®] device, nearly all beneficiaries received at least one call from a care manager during the demonstration and roughly two-thirds of beneficiaries received more than 20 contacts during this same time period. Other than routine contact with the Health Buddy[®] device, outbound telephone contact with the care managers was the most dominant form of contact.

Key Finding #4: Rates of compliance with 5 quality-of-care process measures were high at baseline providing limited opportunity for improvement. The general trends during the demonstration were stable or 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 one measure appropriate for Medicare beneficiaries with ischemic

vascular disease (lipid panel) and four measures appropriate for Medicare beneficiaries with diabetes (HbA1c test, LDL-C test, eye examination, and nephropathy screening) and one composite measure that captures receipt of all four diabetes care measures.

We find no evidence of systematic improvement in rate of receipt of the studied measures. For a number of the quality of care measures, we are likely observing a ceiling effect. However, there is considerable room for improvement for the composite measure that considers receipt of all four diabetes measures. We found four instances of statistically significant rate of receipt differences between the intervention and comparison groups out of 42 comparisons; all signaling a negative intervention effect; however, 23% of the measures were trending in a positive direction. These findings suggest that improving or sustaining adherence to guideline concordant care in a cohort of ill Medicare FFS beneficiaries is challenging.

Key Finding #5: During the course of the Phase II Health Buddy[®] West Program 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.

Across 62 measures of acute care utilization that we examined for the three cohorts and for two time periods within Phase II, we found three statistically significant differences in the rate of growth in acute care utilization in the intended direction and two differences in an unintended direction. The Phase I Refresh intervention group exhibited slower growth in all-cause hospitalizations as well as all-cause and ACSC ER visits relative to the comparison group during the last 12 months of the demonstration using a conventional *p-value* of 0.05 or less. In contrast, a higher percentage of the Phase I Refresh intervention beneficiaries were readmitted for all causes during months 7 through 18 of Phase II and Phase II intervention beneficiaries exhibited a higher ACSC readmission rate during months 20-31 of Phase II. Roughly one-quarter of the utilization measures were trending in a positive direction but did not reach statistical significance.

Key Finding #6: Medicare cost growth was slower in the intervention group in the Phase I Original and Refresh populations and the Phase II population, but none of the trends were statistically significant.

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 402 Phase I Original and 725 Phase I Refresh beneficiaries in the intervention group, we had limited power to detect significant savings. Gross savings had to be 18% in the Phase I Original population and 15% in the Phase I Refresh cohort to be considered significant at the 5% level using a 2-sided confidence level. The Phase II cohort, by contrast, had much larger samples: 2,025 intervention and 2,024 comparison beneficiaries. Even still, gross savings had to be in excess of 12% of comparison PBPM costs to be statistically significant.

Based on RTI's methods, gross savings from the Phase II Health Buddy[®] West Program Demonstration intervention did not approach minimally required savings. Costs rose \$20 slower in the Phase I Original intervention group, and Medicare's return on investment was 0.54,

implying only \$0.54 in savings for every dollar invested in fees. Costs increased \$71 slower in the Phase I Refresh intervention group, resulting in a favorable return on investment of \$1.92 for every \$1 invested in fees. Intervention cohort costs increased \$27 slower in the larger Phase II cohort yielding only \$0.48 in savings for every dollar invested in fees. None of the increases were statistically significant from zero.

Multivariate analysis estimated cost savings for each cohort as well as for a small 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.

Actuarial Research Corporation (ARC), under separate contract to CMS, conducted an actuarial reconciliation of financial performance of the HBC program and also found gross savings for the intervention. ARC-determined savings differed from savings reported by RTI in three ways. First, ARC capped high-cost beneficiaries at the top 1% threshold. RTI did not cap outliers because we did not want to inadvertently bias results against the intervention if it was particularly successful in reducing costs of the very high-cost beneficiaries. Second, ARC adjusted for base period differences in intervention-comparison group costs without taking beneficiary eligibility during the demonstration period into account. RTI down-weighted base period costs for beneficiaries with shorter demonstration period exposure. Third, ARC made no independent assessment of the statistical reliability of their cost estimates. RTI conducted all analyses at the individual beneficiary level to be able to test the reliability of savings. That savings are still positive using a modified ARC approach and RTI's statistical approach suggest that the HBC's intervention is an approach worthy of continued study.

7.2 Conclusion

Based on extensive quantitative analysis of performance using statistical tests at standard 5% confidence levels, we did not detect broad systematic improvement in key processes of care or acute care utilization nor cost savings relative to performance of a comparison group of beneficiaries. The HBC program was successful in reducing the Phase I Refresh intervention group's rate of growth in all-cause hospitalizations as well as all-cause and ACSC ER visits relative to the comparison group during the last 12 months of the demonstration. In contrast, a higher percentage of the Phase I Refresh intervention beneficiaries were readmitted for all causes during months 7 through 18 of Phase II and Phase II intervention beneficiaries exhibited a higher ACSC readmission rate during months 20-31 of Phase II. For almost one-quarter of the 62 acute care utilization measures, we observed slower rates of growth within the intervention populations that were not statistically significant. We also observed an incremental increase in survival benefit among who used the Health Buddy[®] device relative to the comparison group. Although PBPM costs rose slower in the all three intervention groups relative to the comparison groups, statistically significant savings were not achieved.

What might explain the lack of *overall* program effectiveness? One factor may be relatively small sample sizes and lack of statistical power. Only 402 and 725 intervention beneficiaries were available for analysis in the Phase I Original and Refresh groups and smaller numbers in the corresponding comparison groups. In addition, wide variation in beneficiary costs over time made precise estimates of program success difficult with such small samples. Responding to the HBC's request, CMS selected a very costly, complex set of Medicare

beneficiaries for their intervention and comparison groups. Mean per beneficiary per month base year claims costs (weighted by fraction of time eligible for the intervention) ranged from \$774 to \$977, which is considerably higher than in the general Medicare population. Further, we observed extreme regression-to-the-mean (RtoM) behavior among the HBC's selected beneficiaries. The large churning of beneficiaries from lower (higher) to higher (lower) cost groups over time adds considerable statistical noise to the test of savings.

A second factor may be the HBC's beneficiary recruitment challenges. Given the HBC program's monthly management fee (\$132 per month) and the population-based design of this demonstration, engagement of less than one-third of the all eligible intervention population required the HBC program to have been extremely successful with the limited number of participating beneficiaries. One challenge noted was the large number of beneficiaries' contact information that were not correct or operational and the beneficiaries were therefore considered unreachable. However, the greatest challenge facing the program staff was the new "once out always out rule" eligibility criterion imposed during Phase II which they felt 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.

Yet, despite low engagement rates of their full intervention population we do observe an incremental increase in survival benefit among intervention beneficiaries who used the Health Buddy[®] device. As noted before, because we could not directly compare Health Buddy[®] device users with a matched comparison group instead of the entire comparison group, it is possible that unmeasured characteristics explain the survival benefit and not the Health Buddy[®] device itself. However, this finding is consistent with findings in our evaluation of Phase I of the Health Buddy[®] West program and Phase II of the Health Buddy[®] at Montefiore Demonstration program and may imply that the Health Buddy[®] device gives care managers important information on clinical deterioration allowing for timely intervention to prevent a catastrophic event occurring. During site visits in both Phase I and Phase II, care managers relayed the value of the Health Buddy[®] device alerts to help them identify patients in need of greater clinical or educational intervention. They also reported that absence of completed surveys by patients who had been historically compliant with completion of daily surveys was often a strong indicator of clinical deterioration prompting an outbound call from the care manager to the patient. During the site visits, we also heard from physicians and participating beneficiaries many benefits they believed resulted from the use of the Health Buddy[®] device and the care management program. Physicians appreciated the earlier knowledge they received about their patients' medical conditions. It was particularly useful when there was a sudden deterioration in the patients' condition, because it allowed providers to contact patients and intervene appropriately and in a timely manner. Beneficiaries opined that the program helped them maintain focus on their health condition(s) and they liked the reassurance they received that things were going okay. For a more detailed discussion of the perceived impact on day-to-day patient care management, see Section 1.8. Further exploration of the underlying mechanism for achieving the survival benefit would be desirable; our data did not allow for such an examination.

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