Grant Final Report

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Using Telemedicine to Promote Patient Centered Care Among Underserved Individuals

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Principal Investigator:
Alfred A. Bove, MD, PhD

Team members:
William P. Santamore, PhD, Co-Investigator
Carol Homko, RN, PhD, Co-Investigator
Daniel Elliott, MD, Co-Investigator
Mohammed Kashem, MD, PhD, Research Associate
Margaret Kerper, RN, Research Associate

Performing Organization:
Temple University School of Medicine
Philadelphia, PA 19140

Federal Project Officer:
Teresa Zayas Cabán, PhD

Submitted to:
The Agency for Healthcare Research and Quality (AHRQ)
U.S. Department of Health and Human Services
540 Gaither Road
Rockville, MD 20850
www.ahrq.gov

Abstract

Purpose: To evaluate an Internet communication system for reducing blood pressure (BP) in subjects with grade I hypertension.

Scope: BP control is important in cardiovascular disease (CVD) prevention but difficult to achieve in asymptomatic subjects. We hypothesized that Internet communication and self-monitoring would improve BP control in hypertensive subjects compared to usual care.

Methods: 242 patients with BP≥150/90 mmHg were recruited from two medical centers and randomized to usual care (C, N=122) or Telemedicine (T, N=120). The T-group received a digital sphygmomanometer and CVD risk counseling. They were instructed to report BP, HR, weight, steps/day, and tobacco use twice weekly. All patients had baseline and 6-month follow-up visits. The primary end-point was a reduction in systolic BP below 140 mmHg.

Results: Demographics: age- 59±13, female-65%, AA-80%, White-15%, smoker-20%, hyperlipidemia 46%. 206 subjects completed the 6 month study (C-107, T-99). Significant reduction in BP was noted in both groups (C: -14±18, T: -18±20, P=0.1). Non-diabetic subjects (ND) demonstrate a significant telemedicine effect on BP compared to diabetic (D) subjects (ND-C: -12±19, T: -19±20, P=0.037; D-C: -18±17, T: -17±21, P= NS). Adherence was similar for BP, lipid, diabetes medications and aspirin among C and T subjects. T subjects reported BP 7.7±6.9 days/month. Results were not affected by age, sex, ethnicity, education or income.

Key Words: hypertension; telemedicine; patient centered care; underserved; vulnerable populations

Final Report

Purpose

In this study, we are using principles of patient-centered care focused on health knowledge, self-management, and shared decisionmaking to assess the efficacy of an Internet based communication system for reducing blood pressure in asymptomatic individuals with grade I hypertension.

Scope

Background

Although all racial and ethnic groups have experienced declines in cardiovascular disease (CVD) mortality, the extent of these reductions has not been uniformly distributed across all groups. CVD mortality rates have declined less for African-Americans and for people from lower socioeconomic classes than for other groups (1, 2, 3). Half of the disparity in CVD mortality rates between African-Americans and whites is directly attributable to hypertension (4), which has been identified by the Institute of Medicine as a priority area for transforming health care (5). Health care disparities will continue to serve as a significant obstacle for additional reductions in CVD mortality in the 21st century unless innovative changes in health care are taken.

Increased Risk for Hypertension and CVD in African-Americans

African-Americans have a 40% greater prevalence of hypertension compared to whites. Roughly one in three adult African-Americans has hypertension. In a large clinical trial, the percentage of treated but uncontrolled hypertension among African-Americans (35%) and Hispanics (32%) was significantly higher than whites (24%) (6). African-American race/ethnicity was associated with more than a twofold higher risk of hypertension and with treated but still uncontrolled hypertension compared with whites (5). These results are similar to the National Health and Nutrition Examination Survey (6), conducted in 1999 to 2000, which showed a significantly higher prevalence of hypertension and lower rates of hypertension control among African Americans compared with whites.

In Summary

Hypertension, diabetes mellitus, obesity, physical inactivity, and multiple CVD risk factors all occur more frequently in underserved communities and this health disparity is particularly evident among African-Americans. Management of these often asymptomatic disorders requires awareness through education and self monitoring, an understanding of the disease process and consequences of these cardiovascular risk markers, and an understanding of how to become a part of the health care team to achieve improvements in individual health.

Methods

Study Design

We are interested in reducing cardiovascular risk in underserved communities. Our prior work demonstrated that a program that enhances communication and health reminders plus self measured blood pressure improves overall cardiovascular risk as measured by the Framingham risk Score. This study hypothesized that a telemedicine communication system combined with self measured blood pressure would be successful in lowering blood pressure in underserved urban subject with grade I hypertension (Systolic BP$\leq$160 mmHg).

The study focused on asymptomatic subjects who did not have evident cardiovascular disease. This cohort of subjects is at increased risk of CVD, but in most cases subjects are unaware of their increase risk. By increasing awareness of personal risk, we attempted to improve CVD risk by restoring elevated blood pressure to normal.

Subjects. We recruited subjects from inner city Philadelphia and from northern Delaware into the study. Subjects were recruited from medical clinics at Temple University and at Christiana Medical center, by public announcements, health fairs and advertisements in local newspapers. Institutional Review Boards at each institution approved the study.

To be eligible for the study, subjects had systolic blood pressure documented over 150 mmHg and no evidence of overt heart disease. In most cases, recruited subjects had hypertension as their primary CVD risk factor. Because of the target population characteristics, we expected to find a significant number of diabetics, and increased our target recruiting goals to allow a subset analysis of diabetic and non-diabetic subjects.

Intervention. The subjects were randomized to an advanced telemedicine communication system with bidirectional communication for reporting of self-measured blood pressure using a digital sphygmomanometer, and feedback on health status from our research team. Subjects could report via a secure Web site that, after logon, provided education information on hypertension and screens that allowed subjects to enter their blood pressure, heart rate, weight, steps per day from a pedometer and smoking status. They could also send a text message and received text messages from the research team on management of their hypertension. They could also opt to use a telephone communication system where they dialed a toll free number, entered a personal identification number (PIN), and responded to instructions on entering blood pressure and pulse, as well as weight. The telephone system was voice interactive so that individuals could use voice data entry, and could leave voice messages that were recorded as MP3 files for the research staff to hear and respond to. Telemedicine subjects were instructed to send their data twice weekly. Actual treatment for hypertension was provided by individual primary care physicians who received upgrades on status of blood pressure at monthly intervals in the telemedicine subjects. The control group received an initial evaluation, a report about their blood pressure, and advice to follow up with their primary care physician. Subjects in both the telemedicine arm and the control arm were followed for 6 months at which time a final visit was conducted that included evaluation of blood pressure, blood lipids, and completion of a behavior questionnaire.

Results

The study was conducted over a three year period, and a fourth year was incorporated to complete followup and to analyze and process the clinical data. During the second year of recruiting we added another clinical site to accelerate recruiting. The medical clinic of the Christiana medical center in northern Delaware participated in the study to add subjects. This addition achieved a recruiting goal that allowed accurate statistical analysis of the outcome data. Our recruiting goal was 252 subjects with an expected 20% dropout rate. Upon completion of the study we recruited 242 subjects of which 206 completed the 6 month followup period. This final number was within our expected recruiting goal and allowed us to properly power the study for statistical significance.

Principal Findings

Table 1 shows the characteristics of the control and telemedicine subjects. Average age was 60 years, 65% were female and 80% were African-American. More than 50% had family incomes at or near the poverty level. 27% completed high school, and 11% completed college. Approximately 20% of subjects either were covered by Medicaid or had no insurance. No significant demographic differences were noted between control and telemedicine subjects. The majority of the subjects resided in federally designated underserved communities. The large proportion of subjects with income at or below the poverty level, the predominance of minority subjects, dependence on Medicaid and the urban environment defines these subjects as representing a vulnerable population. Our data indicate that this form of communication system can be applied to vulnerable populations with success in lowering blood pressure, which remains a serious risk factor for CVD mortality in this population.

Table 1. Characteristics of the control and telemedicine study groups

		Control N (%)	**Telemedicine N (%)**
	N	122	120
	Female	79 (65)	78 (65)
	Male	42 (35)	42 (35)
	Age (yrs)	58.2±13.5	61.0±13.6
	BMI (kg/m^2)	33.7±7.8	33.7±7.5
Ethnicity	African-American	99 (81)	96 (80)
Ethnicity	Caucasian	17 (14)	18 (15)
Ethnicity	Hispanic	3 (2.5)	4 (3.3)
Ethnicity	Other	3 (2.5)	2 (1.7)
Ethnicity	Diabetes	41 (33)	35 (29)
Ethnicity	Hyperlipidemia	66 (50)	50 (42)
Ethnicity	Smoker	29 (24)	20 (17)

Table 1. Characteristics of the control and telemedicine study groups (continued)

		Control N (%)	Telemedicine N (%)
Education	< High School	17 (14)	22 (18)
Education	High School	44 (36)	30 (25)
Education	Some College	30 (36)	36 (30)
Education	Completed College	13 (11)	14 (12)
Education	Graduate School	13 (11)	9 (8)
Income	<$15,000	43 (35)	35 (29)
Income	$15,000-24,999	25 (20)	25 (21)
Income	$25,000-34,999	7 (6)	6 (5)
Income	$35,000-44,999	13 (11)	11 (9)
Income	$45,000-54,999	9 (7)	9 (8)
Income	>$55,000	21 (17)	24 (20)
Insurance	Medicaid	16 (13)	21 (18)
Insurance	Medicare	38 (31)	44 (37)
Insurance	Private	57 (47)	39 (32)
Insurance	None	9 (7)	4 (3)

Outcomes

Figure 1 shows the overall blood pressure response to this 6-month program in controls and in the telemedicine subjects. For the entire cohort, there was significant improvement in systolic and diastolic blood pressure in both the control and in the telemedicine groups. The systematic participation in the study for both controls and for the telemedicine group allowed an improvement in cardiovascular risk. The telemedicine group trended toward a greater reduction in systolic blood pressure ($p = 0.12$). In addition, there was a significant reduction in blood lipids that was not a planned outcome of the study.

Figure 1. Overall blood pressure response for the entire cohort after 6 months (The telemedicine group trended to a greater reduction in blood pressure p = 0.12)

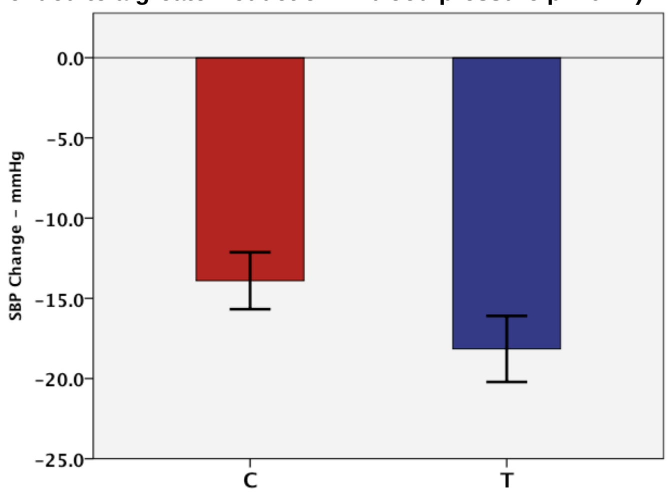


Table 2 shows the proportion of subjects in both groups who reached goal blood pressure. More than half of all subjects reached a goal of <140 mmHg systolic pressure, while 31% of controls and 36% of telemedicine subjects reached a goal of less than 130 mmHg. Table 3 shows the overall results in the 206 subjects who completed the study. Significant reductions in blood pressure and in blood lipids were noted after the 6-month study and blood glucose trended lower (p = 0.062).

Table 2. Percent of subjects in control and telemedicine groups who reached goal blood pressures (No significant differences were noted between the control and telemedicine groups)

	Control (%)	Telemedicine (%)
SBP < 140: All Subjects	52.3	54.5
SBP < 140: Non-diabetics	52.1	58.2
SBP < 140: Diabetics	52.9	46.7
SBP < 130: All Subjects	30.8	36.4
SBP < 130: Non-diabetics	31.5	35.8
SBP < 130: Diabetics	29.4	36.7

SBP-systolic blood pressure, mmHg

Table 3. Change in clinical measures at the end of 6 months: all subjects (P values identify significant changes over the 6-month study period)

Clinical measure	Mean± SD	P-value
Systolic BP (mmHg)	-15.9±19.3	.0001
Diastolic BP (mmHg)	-5.9±11.0	.0001
MAP (mmHg)	-.3±12.3	.0001
Fasting Blood Gluc (mg/dl)	-4.8±35.6	.062
Total Chol (mg/dl)	-9.2±40.6	.002
HDL Chol (mg/dl)	-0.10±11.9	.909
LDL Chol (mg/dl)	-13.7±33.6	.0001
Triglycerides (mg/dl)	16.2±80.7	.006
BMI (kg/m^2)	0.14±3.78	.597

Diabetics vs. non-Diabetics

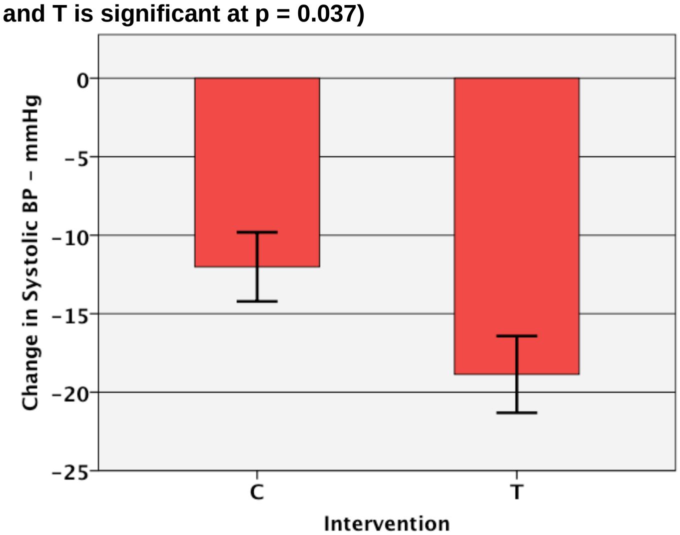
The study was initially designed to examine the effects of the communication system in non-diabetic hypertensive subjects. However, because of the high prevalence of diabetes in the study population we planned to analyze these two cohorts separately.

Non-Diabetics. Table 4 shows the initial and final data for the non-diabetic population. Average age was 58.3 years. Sixty nine percent of the non-diabetic subjects were females, and 81% were African-American. Smoking incidence was approximately 20%, with the control group higher than the telemedicine group. In this group there was a substantial improvement in systolic blood pressure in the telemedicine group compared to the control group (p = 0.037). In addition, total cholesterol and LDL improved significantly in both control and telemedicine groups, identifying an accompanying benefit that appears to link several risk factors for CVD even though only one was being addressed. This linking phenomenon suggests that once subjects become aware of CVD health risk, they incorporate broader health goal into their lifestyle and health care programs. This finding in asymptomatic hypertensive underserved adults also indicates that health awareness is a critical component of reducing CVD risk. A program for self-assessment appears to achieve this goal in subjects who otherwise consider themselves to be in good health. Figure 2 summarized the BP outcome in the non-diabetic subjects.

Table 4. Baseline characteristics and outcome results for the non-diabetic subjects (Significance compares control vs. telemedicine)

	Control (80)	Telemedicine (83)	Significance
Age (years)	55.8±13.6	60.9±14.7	NS
Height (inches)	65.9±3.4	65.8±3.8	NS
Weight (pounds)	197.2±40.8	200.1±48.6	NS
Waist Circ (cm)	40.5±5.2	40.1±5.6	NS
Initial Values: BMI (kg/m^2)	32.0±6.9	32.4±7.3	NS
Initial Values: BP Systolic (mmHg)	152.0±13.8	155.7±13.2	NS
Initial Values: BP Diastolic (mmHg)	88.2±10.0	89.9±11.2	NS
Initial Values: MAP (mmHg)	109.5±9.2	111.8±10.3	NS
Initial Values: FBG (mg/dl)	96.9±16.8	97.2±14.8	NS
Initial Values: Chol Total (mg/dl)	193.8±41.4	186.8±45.4	NS
Initial Values: Chol HDL (mg/dl)	50.6±20.1	55.4±16.2	NS
Initial Values: Chol LDL (mg/dl)	119.5±38.4	112.1±42.4	NS
Initial Values: Triglycerides (mg/dl)	119.9±85.2	96.4±49.7	NS
Initial Values: A1c %	5.78±0.43	5.76±0.47	NS
Change over 6 months: BMI (kg/m^2)	0.2±4.5	-0.1±2.8	NS
Change over 6 months: BP Systolic (mmHg)	-12.0±18.7	-18.9±20.0	.037
Change over 6 months: BP Diastolic (mmHg)	-4.6±10.3	-7.6±12.3	NS
Change over 6 months: MAP (mmHg)	-7.1±11.6	-11.4±13.5	.047
Change over 6 months: FBG (mg/dl)	2.4±19.4	-3.3±15.7	.066
Change over 6 months: Chol Total (mg/dl)	-8.2±34.7	-9.5±35.1	NS
Change over 6 months: Chol HDL (mg/dl)	1.1±12.2	-0.4±12.5	NS
Change over 6 months: Chol LDL (mg/dl)	-15.0±28.6	-15.1±30.5	NS
Change over 6 months: Triglycerides (mg/dl)	17.3±78.0	20.6±60.4	NS
Males	26 (32.5)	25 (30.1)	NS
African-American	64 (80.0)	69 (83.1)	NS
Caucasian	12 (15.0)	12 (14.5)	NS
Hispanic	2 (2.5)	1 (1.2)	NS
Smoker	21 (26.3)	12 (14.5)	NS

Figure 2. Change in systolic BP for the non diabetic group (C-control, T-telemedicine. Difference between C and T is significant at p = 0.037)



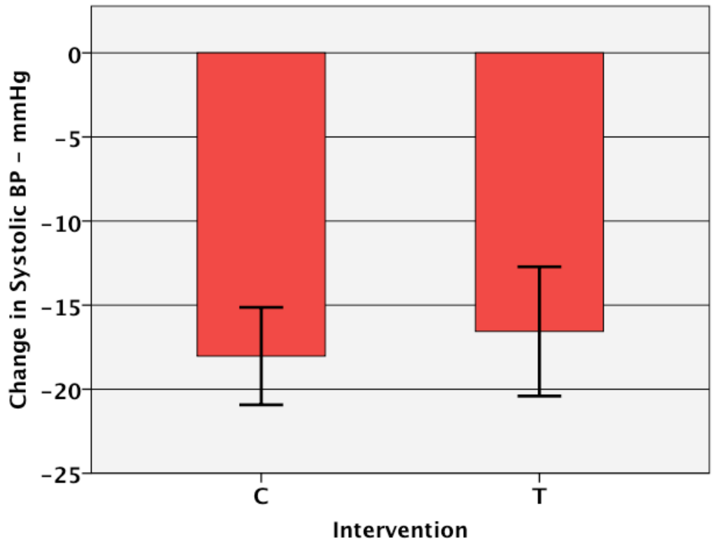
Diabetics. Results from the diabetic population are shown in Table 5. Note that the subjects in both control and telemedicine groups all improved both blood pressure and blood lipids, and there was a trend toward improvement in FBG. Significant changes favoring the telemedicine group were noted in Triglycerides and BMI. However, the Telemedicine group had a less favorable response to blood glucose compared to controls. This group showed equal blood pressure responses in the telemedicine and the control groups. However, all of these subjects had an established diagnosis of type II diabetes, and were under the care of a primary care physician, therefore were aware of their health status. In this group the reminder system had less effect, as the subjects were already involved in self-care of their health condition and had developed health care strategies to improve their CVD risk.

Table 5. Baseline characteristics and outcome results for the subject with diabetes (Significance compares control vs. telemedicine)

	Control (80)	**Telemedicine (83)**	**Significance**
Age (years)	63.0±12.0	61.3±9.9	NS
Height (inches)	66.0±3.7	65.6±3.7	NS
Weight (pounds)	229.1±54.8	224.3±51.3	NS
Waist Circ (cm)	45.4±7.0	44.5±6.2	NS
Initial Values: BMI (kg/m2)	37.0±8.5	36.6±7.3	NS
Initial Values: BP Systolic (mmHg)	159.0±19.7	156.4±15.2	NS
Initial Values: BP Diastolic (mmHg)	86.4±12.6	86.5±11.0	NS
Initial Values: MAP (mmHg)	110.6±13.3	109.8±10.3	NS
Initial Values: FBG (mg/dl)	157.5±69.2	147.0±61.9	NS
Initial Values: Chol Total (mg/dl)	175.7±43.4	181.9±52.3	NS
Initial Values: Chol HDL (mg/dl)	46.8±15.6	43.6±12.1	NS
Initial Values: Chol LDL (mg/dl)	107.1±38.4	106.6±46.8	NS
Initial Values: Triglycerides (mg/dl)	110.6±59.3	171.56±124.7	.007
Initial Values: A1c %	7.55±1.81	8.38±2.53	NS
Change over 6 months: BMI (kg/m2)	1.2±4.4	-0.6±2.6	.049
Change over 6 months: BP Systolic (mmHg)	-18.0±16.6	-16.6±21.0	NS
Change over 6 months: BP Diastolic (mmHg)	-5.5±10.1	-5.9±10.8	NS
Change over 6 months: MAP (mmHg)	-9.7±10.5	-9.4±12.7	NS
Change over 6 months: FBG (mg/dl)	-23.8±63.4	-3.6±47.9	NS
Change over 6 months: Chol Total (mg/dl)	-2.0±36.1	-19.8±65.0	NS
Change over 6 months: Chol HDL (mg/dl)	-0.4±10.3	-2.0±11.4	NS
Change over 6 months: Chol LDL (mg/dl)	-9.2±29.9	-12.9±53.1	NS
Change over 6 months: Triglycerides (mg/dl)	36.9±96.1	-21.6±99.3	.023
Males	16 (39.0)	17 (48.6)	NS
African-American	35 (85.4)	25 (71.4)	NS
Caucasian	5 (12.2)	6 17.1)	NS
Hispanic	1 (2.4)	3 (8.6)	NS
Smoker	8 (19.5)	7 (20.0)	NS

Figure 3 compares the systolic blood pressure response in telemedicine and control subjects among diabetic subjects. The reduction in BP is similar in the control and telemedicine subjects with diabetes.

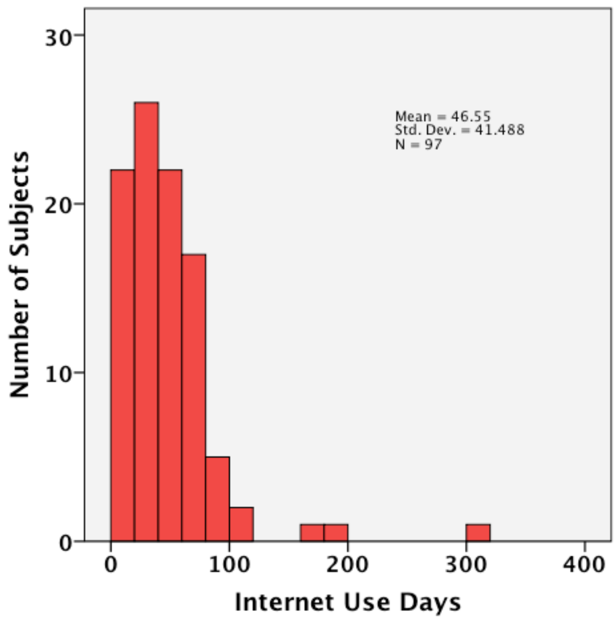
Figure 3. Change in systolic BP for diabetics after 6 months (C-control, T-telemedicine. Both control and telemedicine groups showed significant reductions in systolic BP that were similar in magnitude)



Internet Utilization

The use of advanced communication systems provides the opportunity to evaluate use behavior for the subjects who used the telemedicine system. This system allowed use of a computer for input using a Web browser, or telephone input and two way communication using the telephone keypad and Internet voice recognition methodologies. The telemedicine subjects used telephone communication 65% of the time and Internet communication 35% of the time. This is not surprising as we added telephone capability for bidirectional communication due to the lack of access to personal computers and the Internet in the inner city underserved neighborhoods. On the other hand, cell phone use is ubiquitous and became the communication choice for nearly two thirds of the subjects. Frequency of use is shown in Figure 4. Average use by subject was 46.5 transmissions in 6 months (equivalent to 1.8 communications per week). We did not find a correlation between blood pressure outcome and utilization frequency, between age and utilization frequency, or between family income and utilization frequency. We did find a positive correlation between education level and utilization frequency.

Figure 4. Distribution of Internet utilization in the T group (Data show number of days of use for the 6-month study. Mean Internet use for the T group was 46.5 reports in 6 months (7.75 reports/month))



Measures of Behavior and Adherence

We provided all subjects with questionnaires to complete at the beginning and end of the study. These were designed to analyze medication adherence, health knowledge, and health care decision making. In addition, the CAHPS questionnaire was competed at the beginning and end of the study. We found no effects of Internet accessibility, ethnic background, age, sex, education, or family income on overall study outcomes. Similarly, none of these factors had any effect on outcome comparing control and telemedicine groups. As noted above, presence or absence of diabetes did influence the effects of the telemedicine intervention on outcomes. As shown in Table 6, adherence to hypertensive medications, aspirin, hyperlipidemia medications and diabetes medications were similar in the control and telemedicine groups. Figure 5 shows similar adherence for hypertensive medications in the control and telemedicine groups, and Figure 6 shows a significantly higher compliance with lipid lowering medications in the diabetes group compared to the non-diabetes group.

Table 6. Adherence score for four categories of medications in control and telemedicine groups (A score of 4 indicates 100% adherence. No significant differences were noted between the groups for any medication category.)

Medication Category	Control	Telemedicine
Hypertension	3.67±0.89	3.60±0.87
Aspirin	3.00±1.62	2.68±1.70
Hyperlipidemia	2.64±1.78	2.65±1.79
Diabetes	2.42±1.96	2.60±1.90

Figure 5. Average medication adherence based on a score of 1 to 4 comparing control and telemedicine groups (No differences are noted between the groups.)

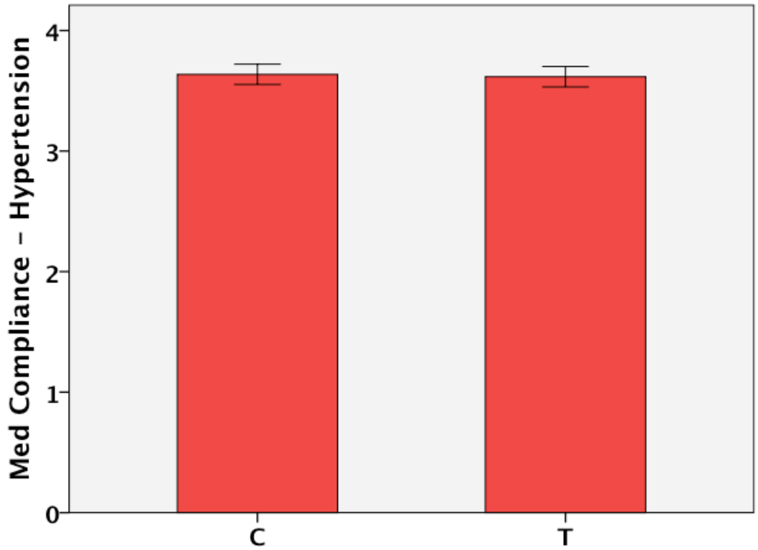
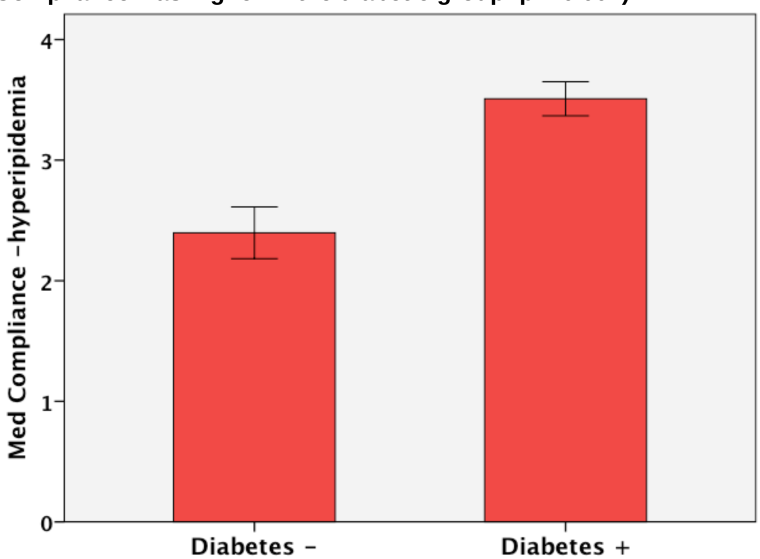


Figure 6. Medication adherence score for lipid lowering medication comparing diabetics to non-diabetics (Compliance was higher in the diabetic group: p < 0.001)



Physician-Patient Interaction

We examined the number of hypertensive medications that were prescribed for each study subject. In the control group there was no change in average number of medications over the 6-month study period (1.95±1.02 to 1.91±1.21, $p=0.468$). In the telemedicine group there was a significant increase in prescribed medications (2.20±1.20 to 2.34±1.15, $p=0.004$). Multivariate analysis showed no effect on prescribed medications with respect to age, ethnicity, education, or income. We interpret these findings as indicating that the monthly reminders that reported blood pressure data and JNC VII guidelines to the primary care physician, with the same information provided to the patient, encouraged physicians to pay attention to patient's blood pressure. The fact that both physician and patient were aware of the blood pressure data and the treatment goals appears to encourage better control of blood pressure through interaction between the patient and physician that allowed sharing of care plans between patient and physician. Although we offered the physicians access to the Internet-based patient information, no physician used the system to examine patient status. We experienced this behavior in previous Telemedicine studies, and designed an autofax system to provide information to the primary care physicians. This fax system appeared to be effective based on physician prescribing of antihypertensive medications, and the greater reduction in blood pressure in the telemedicine group.

Our survey of patient-physician interaction indicated that 98% of patients reported that their blood pressure was recorded during the office visit, and 94% discussed BP management with their physician. 85% of subjects were aware of their BP goal, and 79% informed their physician of their BP goal. Sixty percent of patients discussed lifestyle changes with their physician. These findings were similar in the control and telemedicine groups.

CAHPS Survey. This survey examines the patient to physician interaction. It asks five questions regarding health care availability, six questions on patient to physician communications, two questions about office staff, and an overall assessment of the physician encounter experience and assessment of personal health. The questionnaire was administered to all subjects in the study at the initial and final visits. Table 7 provides overall results of the surveys. Data in the table represent the proportion of subjects who responded positively to the questions. A "yes" answer was recorded as a positive response in questions with a binary response, and a response of "usually" or "always" was recorded as a positive response in questions with a 4 point response (always, usually, sometimes, never). In both Control and Telemedicine groups a positive response of about 70% was recorded on both initial and final questionnaires. There was no change in patient perception of health care availability over the 6-month study in either group. Communication was graded in the mid-nineties for the Control group, and, while somewhat lower at the initial visit in the Telemedicine group, there was a significant increase in the percent of subjects who responded positively. This increase in communication assessment was significant. Also of note, is the initial difference between control subjects and Telemedicine subjects regarding patient-physician communication. Since subjects were assigned randomly to the control and Telemedicine groups, this cannot be explained by selection bias. The data of table 1 demonstrate a high level of similarity between the two groups in age, ethnic makeup, education, income and insurance, and supports this conclusion. The improved communication noted over the 6-month study in the Telemedicine group could be interpreted as indicating that better blood pressure management can be achieved if patient perform self-measures on a periodic basis, and the data are aggregated and a summary report sent to the physician on a monthly basis. For hypertension, where frequent observation of blood pressure can guide therapy, this system offers a solution to the long term management of hypertension at minimal cost.

Table 7. CAHPS analysis (Percentages are proportion of subjects who responded favorably to questions on health care measure noted in the left column. For questions with a binary response, the value is percent of "yes" responses. For questions with a graded response, the values are the % of subjects who responded with either "usually" or "always." Question 23 asks for an overall estimate of the physician encounters on a 1-10 scale with positive responses considered with scores of 8-10. Question 26 is a rating of personal health on a 1-5 scale with positive responses considered 4 or 5. Numbers in parentheses in left column are the number of questions in each category.)

		Control: Initial	Control: final	Telemedicine: Initial	Telemedicine: final
Appts/health care when needed (5)	mean	71%	73%	71%	69%
Appts/health care when needed (5)	SD	11%	16%	21%	19%
How Well Dr. Communicates (6)	mean	95%	94%	89%†	93%*
How Well Dr. Communicates (6)	SD	3%	1%	2%	1%
Office Staff (2)	mean	60%	62%	54%	58%
Office Staff (2)	SD	52%	1%	47%	4%
Overall (14)	mean	84%	85%	80%	82%
Overall (14)	SD	14%	14%	15%	16%
Overall (Q 23)		93%	89%	79%	78%
Rate Health (Q26)		60%	68%	61%	65%

* Significant initial to final difference, $p < 0.001$. † Significant difference between Control and Telemedicine groups, $p < 0.001$

Conclusions and Significance

Several important observations can be drawn from the study that are likely to impact programs to improve CVD outcomes in at risk individuals without symptoms. There is a clear finding that all subjects who participated in the study gained some benefit, with significant lowering of blood pressure in both the control group and the telemedicine group. In the subset of individuals without diabetes, who were asymptomatic and not likely to be continuously engaged in their health care, there was a significant advantage with the use of the telemedicine system. It is clear however that any means of getting individuals engaged in their health care to understand CVD risk and the means to improve risk will have benefit. This would best be achieved by a patient-centered approach to self-care and health literacy, which has been identified by the Institute of Medicine as a priority area for transforming health care (5). Our telemedicine system was designed to be used by individuals with computer access as well as individuals who could respond by telephone. We designed the system to automate both telephone and Web-based reminders about self-assessment of blood pressure and other risk factors, and to report using either a Web screen or the telephone keypad. The fact that 65% of the subjects used the phone system indicates that this means of communication can be used on a larger scale to reduce population risk. Use of mobile telephones is ubiquitous and has become the communication choice in the underserved community because of the favorable economics of this form of telephone use. Designing automated telephone communications that are concise, educational and relevant poses a challenge but at the same time does succeed in engaging individuals in their personal health care. Such reminder and data reporting systems can be one important means of achieving the goals of the new Federal Million Hearts program (for more information go to: http://millionhearts.hhs.gov) to reduce the incidence of heart attack and stroke over the next five years.

Integration and Sustainability. These communication systems are readily managed by specially trained nurses, pharmacists or physician assistants with physician backup for patients who do not respond to the initial surveillance and advice. Periodic communication and self-assessment seems to motivate subjects to be health conscious, and this component of care can be delegated to a physician-led care team that leaves the most complex management issues to a physician while less complex management can be accomplished by non-physician providers. These systems can be automated to minimize time commitments of health care providers and reduce costs of screening and prevention programs. They can be offered to a large cohort of individuals by health care systems, linked with community centers, churches, libraries, and worksites. Such systems are readily scalable as the main component of the system is a patient database and personal health record. Minimal hardware is needed, and many subjects can take advantage of free biometric systems available in worksites, pharmacies, and other health centers to obtain their health status data. Sustainability requires maintenance of servers and periodic updates of software applications. Review of data and advice on risk management could then be offered by individual patient centered practices linked to the communication system.

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List of Publications and Products

We closed and verified our main database for the study in September 2011. The main outcome paper and several abstracts are in preparation. One preliminary abstract (below) was presented at the American College of Cardiology meeting in April 2011.

Kashem A, Kerper M, Homko CJ, Santamore WP, Hewitt V, Eubanks A, Raza F, Reed A , Alkhouli M, Bove AA. Hypertension Management in Urban Underserved Patients Using an Internet Communication System. *JACC* 2011;57 (Apr):E1280.