# Linking Community-Based Blood Pressure Measurement to Clinical Care: A Randomized Controlled Trial of Outreach and Tracking by Community Health Workers

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## ABSTRACT

*Objectives.* This study assessed the effectiveness of enhanced tracking and follow-up services provided by community health workers in promoting medical follow-up of persons whose elevated blood pressures were detected during blood pressure measurement at urban community sites.

*Methods.* In a randomized controlled trial, 421 participants received either enhanced or usual referrals to care. Participants were 18 years or older, were either Black or White, and had blood pressure greater than or equal to 140/90 mm Hg and income equal to or less than 200% of poverty. The primary outcome measure was completion of a medical follow-up visit within 90 days of referral.

*Results.* The enhanced intervention increased follow-up by 39.4% (95% confidence interval [CI] = 14%, 71%; $P = .001$) relative to usual care. Follow-up visits were completed by 65.1% of participants in the intervention group, compared with 46.7% of those in the usual-care group. The number needed to treat was 5 clients (95% CI = 3, 13) per additional follow-up visit realized.

*Conclusions.* Enhanced tracking and outreach increased the proportion of persons with elevated blood pressure detected during community measurement who followed up with medical care. (*Am J Public Health.* 1999;89: 856–861)


Uncontrolled hypertension remains a major public health issue. In the United States, 32% of adults with hypertension are unaware that they have elevated blood pressure, and only 27% have adequately controlled blood pressure.[1] The levels of awareness and control appear to have declined in recent years.[1]

One strategy to improve hypertension awareness and control is through community-based blood pressure measurement programs.[2,3] Up to one third of persons whose blood pressures are assessed in community blood pressure measurement programs have elevated levels,[4–17] and about one third of these are unaware that they have high blood pressure.[4,6,8–10,14–16] In addition, community blood pressure measurement programs identify persons with treated hypertension who have poorly controlled blood pressures.[4,6,8–10]

Community monitoring programs are effective only if clients with increased blood pressure receive appropriate clinical follow-up.[7,18–22] Yet rates of reported follow-up have ranged from 29% to 90%,[7,9,23,24] with the more recent of these studies reporting lower rates. Many monitoring programs lack sufficient mechanisms to ensure adequate follow-up.[22,25–28] Most programs simply suggest that clients with elevated blood pressure have their pressure rechecked.[13,29] In contrast, emergency departments[30–32] and clinical sites[6,21,23,25] have employed more intensive registry-based tracking and outreach systems. Although experts have recommended that such systems be used by community-based programs,[22] only one such use has been reported.[33]

In addition, the effectiveness of follow-up activities at any type of site has not been carefully evaluated.[14,16,34] We are aware of only one previous randomized trial demonstrating the effectiveness of an intervention to enhance follow-up, and this took place in an emergency department rather than a community setting.[32] We therefore conducted a randomized controlled trial to determine whether a tracking and outreach intervention delivered by community health workers improved medical follow-up of persons whose elevated blood pressure was detected during blood pressure measurement at community sites.

## Methods

### *Setting and Participants*

The study was conducted by the Seattle Hypertension Intervention Project in low-income neighborhoods in Seattle from June 1994 through October 1996. Community health workers conducted blood pressure measurements at social service agencies, food banks, shelters and missions, public libraries, grocery and other retail stores, shopping malls, community centers, motor vehicle licensing sites, employment security offices, post offices, the local jail, and work-release sites.

Persons with elevated blood pressure (≥ 140 mm Hg systolic or ≥ 90 mm Hg diastolic) were eligible to participate in the study

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if they were at least 18 years of age, were Black or White, and had incomes less than or equal to 200% of the 1995 federal poverty level. Three seated blood pressure determinations (performed with a Baumanometer desktop mercury sphygmomanometer, a Classic II stethoscope, and an appropriately sized cuff) were carried out according to the protocols of the American Society of Hypertension,[35] and the average of the last 2 measurements was used to compute blood pressure. We restricted enrollment to 2 racial groups (Black and White) to have sufficient participants in each group to permit an analysis stratified by race; the 2 groups chosen have the highest prevalence of hypertension in the Seattle area.[36] We focused on low-income persons because they experience more difficulties accessing health care.[37] The study was reviewed and approved by the Human Subjects Protection Division of the University of Washington. All participants provided informed consent and received an incentive of $25 for completing the study.

After blood pressure measurement and administration of the enrollment questionnaire, each participant was randomly assigned to either the intervention group or the usual-care group. The randomization procedure used sequentially numbered, sealed, opaque envelopes containing slips of paper indicating group assignment, based on computer-generated random numbers.

### *Intervention Conditions*

The same community health workers who had performed the blood pressure measurements provided the following services for the enhanced tracking and outreach intervention group: (1) referral to medical care and, if necessary, assistance in locating a provider; (2) an appointment made by the health worker using a cellular phone or telephone follow-up by the health worker with clients who preferred to make their own appointments to assure an appointment was made; (3) an appointment reminder letter; (4) follow-up to determine whether the appointment was kept; (5) a new appointment for each missed appointment (up to 3); and (6) assistance in reducing barriers to care through referral to community transportation, child care, or other services. Standard guidelines were followed in determining the interval from blood pressure measurement to appointment.[38]

The community health workers were predominantly Black (12/14) and all came from low-income neighborhoods similar to the ones in which the project was conducted. They received 100 hours of training on hypertension, the cardiovascular system, risk factors for cardiovascular disease, community resources, research methods, stress management, and alcohol and other drugs, and they were certified as blood pressure measurement specialists.[39,40] The health workers followed a standardized sequence of activities until they reached a client: telephoning (up to 3 times), mailing a postcard asking the client to contact the health worker, making a home visit, and contacting alternate persons who might know the location of the client. If the client remained unavailable, he or she was considered lost to follow-up. Contact activities were monitored with a computerized tracking system.

Participants in the usual-care group were advised to see a health care provider for follow-up. Those without a provider were given a list of public and community clinics.

### *Outcome Measures and Data Collection*

The primary (predetermined) end point was completion of a follow-up appointment with a medical care provider within 90 days of referral. Completion of the follow-up appointment was ascertained at an exit interview 3 months after enrollment, with confirmation by the medical care provider. Provider reports, which were available for 94% of the participants who reported completing visits, were accepted as indicating the final appointment status for these participants, while self-reports were used for the remainder.

Data collected at enrollment consisted of demographic information; blood pressure; health insurance coverage and access to medical care; history of blood pressure measurement, awareness, and control; knowledge, attitudes, and behaviors related to blood pressure control; psychosocial stress levels[41,42]; and experience of discrimination in receiving medical care.[43] The exit interview collected similar information and included additional questions about satisfaction with services received. Exit data were collected by an interviewer who had had no previous contact with the participant and who did not know the participant's assignment status.

### *Statistical Analysis*

Comparisons between the intervention and usual-care groups were tested for statistical significance with SPSS 5.2[44] by 2-tailed $t$ tests for continuous variables and by $\chi^2$ tests with the Yates continuity correction for categorical variables, with the threshold for statistical significance set at $P$ less than .05. Confidence intervals for relative risks, risk differences, and number needed to treat were computed with Epi Info 6.[45] Logistic regression was performed with Stata 5.0[46] to assess for confounding and interactions.

We estimated that 40% of the participants would complete a follow-up appointment in the absence of enhanced tracking and outreach. To detect a 40% relative increase in the follow-up rate (i.e., a rate of 56%) among the intervention group with 95% confidence ($\alpha = .05$) and 80% power ($\beta = .20$), we estimated that we would need 164 participants in each group.

Participants lost to follow-up were censored from the final analysis of the intervention's effectiveness.

## *Results*

### *Participants: Characteristics, Flow, and Follow-up*

Of the 4761 persons who received blood pressure measurements, 759 (15.9%) were eligible for enrollment. Of those eligible, 421 (55.5%) enrolled in the study; 209 were randomly assigned to the intervention group and 212 to the usual-care group. After randomization, 14 usual-care group members and 10 intervention group members failed to complete the enrollment protocol and did not continue in the study.

The characteristics of the 4761 persons who received blood pressure measurements are described in Table 1. Many (40%) were uninsured, and nearly 20% had not had their blood pressure checked for a year or longer. Nearly one third had elevated blood pressure, and 11% had moderately or severely elevated pressure. Among those with elevated blood pressure, 63% reported that they had been told they had hypertension and 41% reported that they were currently using blood pressure medications.

Study participants were predominantly Black, middle-aged, male, poor, and unlikely to have received education beyond high school (Table 1). A third had moderately or severely elevated blood pressure. About two thirds had previously been told they had high blood pressure, and many (40%) were taking antihypertensive medications. Three quarters reported having had their blood pressure checked within the past 6 months, but 12% had not had their blood pressure checked for a year or longer.

Study participants differed somewhat from eligible persons who chose not to enroll. Study participants were more likely to be Black, young, and male, and they had slightly lower mean systolic and slightly higher mean diastolic blood pressures (Table 1); they had a longer duration of hypertension diagnosis and were more likely to believe that hypertension is a very serious problem (data not shown).

The intervention and usual-care groups were virtually identical across all characteristics measured, indicating successful randomization (Table 2). In particular, the groups did not differ with respect to characteristics that may be related to keeping follow-up appointments.

A total of 311 (74%) of the enrolled participants, 146 (70%) in the intervention group and 165 (78%) in the usual-care group, completed their 3-month exit interviews. The difference in study completion rates was not significant ($P = .08$). Of the 110 participants who did not complete the study, 24 (6% of those randomized) did not complete the enrollment questionnaire, 75 (18% of those randomized) were lost to follow-up, and 11 (3% of those randomized) withdrew during the study. Compared with participants who remained in the study, those lost to follow-up were significantly more likely to be White, young, and recruited from the jail. Because the follow-up appointment status of participants who did not complete the study was unknown, we excluded them from further analysis.

There were no significant differences in demographic characteristics, hypertension histories, or blood pressures at enrollment between intervention and usual-care participants who did complete the study, making it less likely that the small difference in completion rates between the usual-care and intervention groups biased the results of the study.

Of persons in the intervention group who completed a follow-up appointment within 90 days of referral, 90.4% kept their first appointment, 8.9% missed the first appointment and required a second appointment, and 0.7% required 3 or more appointments.

### *Effectiveness of the Intervention*

The outreach and tracking intervention increased the rate of follow-up with medical care by 39.4% (95% confidence interval [CI] = 14%, 71%; $P = .001$) relative to usual care. While 65.1% (95/146) of the intervention group completed a medical appointment within 90 days of referral, only 46.7% (77/165) of the usual-care group did so ($\chi^2 = 10.61$, $P = .001$). The absolute increase in follow-up was 18.4 per 100 persons served (95% CI = 8%, 33%), and the number of persons served to bring 1 person to care (i.e., the number needed to treat) was 5 (95% CI = 3, 13).

### *Logistic Regression Analysis*

We used logistic regression analysis to assess for possible confounding of the intervention effect by other variables associated with completing follow-up appointments. Age, sex, awareness of hypertension, and current use of antihypertensive medications were the only variables shown in Table 1 that were significantly ($P < .05$) associated with appointment completion in univariate analysis. Awareness and medication use were highly correlated ($r = 0.58$). Therefore, we constructed a logistic regression model with appointment completion as the dependent variable, study group status as the main independent variable, and age, sex, and medication use as potentially confounding variables. The addition of the potential confounding factors increased the odds ratio for the intervention from 2.13 (95% CI = 1.35, 3.36) to 2.30 (95% CI = 1.42, 3.74).

No significant ($P < .05$) interactions between intervention and age, sex, and race were present. The intervention thus appeared to be equally effective across ages, sexes, and races, although the sample size limited the study's ability to detect small differences in efficacy (<50% with 80% power) across subgroups.

**TABLE 1—Characteristics of Persons Whose Blood Pressure Was Measured by the Seattle Hypertension Intervention Project, June 1994–October 1996**

| | Eligible Persons Who Enrolled in the Study (n = 421) | Eligible Persons Who Did Not Enroll in the Study (n = 338) | All Persons Whose Blood Pressure Was Measured (n = 4761) |
|---|---|---|---|
| **Demographic characteristics, %** | | | |
| Age, y | | | |
| 18–39 | 24.9 | 17.5[a] | 42.8 |
| 40–64 | 56.8 | 46.7 | 41.3 |
| ≥65 | 18.3 | 35.8 | 15.9 |
| Race: Black | 79.1 | 64.5[a] | 48.3 |
| Sex: male | 72.2 | 56.2[a] | 67.4 |
| Income ≤ federal poverty level | 66.3 | 60.5 | 46.2 |
| Education | | | |
| < High school | 24.3 | 22.3 | 20.2 |
| High school graduate | 40.7 | 40.8 | 35.8 |
| > High school | 35.0 | 36.9 | 43.9 |
| **Blood pressure (BP)** | | | |
| Systolic BP, mean, mm Hg | 146.0 | 148.5[b] | 127.3 |
| Diastolic BP, mean, mm Hg | 94.0 | 91.9[b] | 80.9 |
| BP ≥ 140/90, % | 100.0 | 100.0 | 31.4 |
| BP ≥ 160/100, % | 33.3 | 35.2 | 10.7 |
| Last BP check, % | | | |
| < 3 mo | 64.2 | 63.6 | 50.2 |
| 3–12 mo | 24.3 | 22.2 | 30.2 |
| > 12 mo | 11.5 | 14.2 | 19.6 |
| Aware of hypertension, % | 67.0 | 62.7 | 34.0 |
| Taking antihypertensive medication, % | 39.7 | 44.7 | 20.1 |

[a]Difference between enrolled and nonenrolled eligible persons significant at $P < .0001$.
[b]Difference between enrolled and nonenrolled eligible persons significant at $P < .05$.

## *Discussion*

With usual support in obtaining follow-up medical attention, only half of the people with elevated blood pressure detected during community monitoring completed a follow-up appointment within 90 days. Follow-up rates increased significantly, by 39.4%, as a result of an intervention in which the community health workers who performed the blood pressure measurements also provided referral, outreach and tracking services, and client education.

Several factors may have contributed to the effectiveness of this program. The community health workers, who were Black and had grown up in communities similar to the ones they worked in during this project,[47] were able to identify with their clients and provide culturally appropriate services. Other factors that may have had an impact include the choice of blood pressure monitoring sites, careful adherence to tracking protocols, the use of computers to assist in tracking, and high project visibility in the community. The intervention might have been nearly as effective even if it had been conducted less intensively. Because fewer than 10% of those completing follow-up appointments required more than one appointment to do so, it might have been more cost-effective to assist clients in making an appointment only once.

Our program reached people who had limited access to blood pressure measurement, particularly in clinical settings. A large proportion of the participants in this study

**TABLE 2—Characteristics of Intervention and Usual-Care Groups: Seattle Hypertension Intervention Project, June 1994–October 1996**

| | Intervention Group (n = 209) | Usual-Care Group[a] (n = 212) |
|---|---|---|
| **Demographic characteristics, %** | | |
| Age, y | | |
| 18–39 | 25.8 | 24.1 |
| 40–64 | 56.0 | 57.5 |
| ≥65 | 18.2 | 18.4 |
| Race: Black | 79.4 | 78.8 |
| Sex: male | 71.8 | 72.6 |
| Income ≤ federal poverty level | 64.1 | 68.4 |
| Education | | |
| <High school | 22.1 | 26.4 |
| High school graduate | 41.3 | 40.1 |
| >High school | 36.5 | 33.5 |
| **Blood pressure (BP)** | | |
| Systolic BP, mean, mm Hg | 145.5 | 146.5 |
| Diastolic BP, mean, mm Hg | 94.0 | 93.9 |
| BP ≥ 140/90, % | 100 | 100 |
| BP ≥ 160/100, % | 33.0 | 33.5 |
| Last BP check, % | | |
| <3 mo | 61.8 | 66.5 |
| 3–12 mo | 26.6 | 22.3 |
| >12 mo | 11.6 | 11.3 |
| Aware of hypertension, % | 68.9 | 65.1 |
| Taking antihypertensive medication, % | 40.2 | 39.2 |
| **Health care utilization** | | |
| Have usual source of care, % | 87.0 | 87.3 |
| Miss appointments, % | | |
| Never | 58.0 | 59.8 |
| Sometimes | 30.4 | 25.2 |
| Most/all | 11.6 | 15.0 |
| Mean no. of days since last doctor visit | 153.3 | 160.8 |
| **Study completion status, no.** | | |
| Completed | 146 | 165 |
| Did not complete enrollment | 10 | 14 |
| Lost to follow-up | 45 | 30 |
| Withdrew | 8 | 3 |

[a]None of the differences between intervention and usual-care participants were significant at $P<.05$.

were young, uninsured men, and such persons typically lack access to medical care.[48] The percentage of persons screened who reported not having had their blood pressure measured in the past year (20%) was nearly 50% higher than the rate among the US adult population (13%; S. Bland, MS [zee1@cdc.gov], Centers for Disease Control and Prevention Behavioral Risk Factor Surveillance System, e-mail, March 18, 1997) and 25% higher than the rate among the adult population of the greater Seattle area.[36]

The intervention had several limitations. First, blood pressure measurements were taken at a single sitting. Only 60% to 70% of those tested would be expected to have elevated pressures during reexamination.[4,6,7,9,11,16,49,50] An alternative strategy would have been to remeasure blood pressure at a second session and refer to care only those who had elevated pressure on both occasions. However, the costs of additional tracking by health workers and the risk of losing participants to follow-up seemed to outweigh the benefits of this strategy. (This hypothesis could be tested through further study.)

Second, this program had a circumscribed goal: to improve follow-up with enhanced care. We did not attempt to evaluate long-term control of blood pressure and therefore cannot state whether this program resulted in improved control of hypertension. However, referring people with hypertension to clinical care is a necessary precondition for controlling blood pressure.[22]

Third, the magnitude of the intervention effect might have been somewhat overestimated because participants who dropped out might have been less likely than those who did not to respond to the intervention. Participants who dropped out tended to be young, male, and incarcerated. However, logistic regression analysis found no interaction between these attributes and the intervention. Loss of participants to follow-up might also have biased our findings if the characteristics of those who remained in the intervention group differed from the characteristics of those who remained in the usual-care group. There were no significant demographic differences, however, between intervention and usual-care participants who did complete the study. The effectiveness of the intervention among those completing the study was actually increased after adjustment for potential confounding variables such as age, sex, and medication use.

Fourth, ascertainment of the primary end point was limited. Although we were able to confirm the follow-up of participants who reported that they did keep their appointments, we could not verify that those who reported no follow-up did not see a provider.

The effectiveness of an enhanced tracking and outreach program may vary across different populations. Our goal was to reach male, low-income, and Black persons because such persons have a relatively high prevalence of hypertension[2,51,52] and limited utilization of routine health services.[37] Our findings may not apply to other populations. However, subgroup analysis showed that the intervention was equally effective among male and female, Black and White, and younger and older participants. The program's effectiveness may also vary in different locations. Seattle has a well-developed network of "safety net" providers (including community and health department clinics as well as a public hospital), which may make obtaining follow-up care for hypertension easier in Seattle than in other urban locations. Yet despite this network, 20% of the uninsured population of Seattle report difficulties in obtaining needed medical care,[53] a somewhat higher percentage than the proportion reported in a recent national survey.[37]

In addition to successfully identifying low-income urban residents with elevated blood pressure, the Seattle Hypertension Intervention Project demonstrated that community health workers who offer outreach and tracking services can significantly improve use of follow-up medical care among clients with hypertension. Community blood pressure measurement programs should employ community health workers to perform such services. □

## Contributors

J. Krieger was involved in the initial conception of the intervention, designed the evaluation, participated in implementing the intervention, designed and reviewed the results of the data analysis, and jointly wrote the manuscript with the other authors. C. Collier participated in designing and led in implementing the evaluation and intervention, participated

in designing and conducting the data analysis, and contributed to writing the manuscript. L. Song participated in designing the evaluation and contributed to designing and conducting the data analysis and writing the manuscript. D. Martin contributed to designing the evaluation and participated in analyzing the data and editing the manuscript. All authors approved the final version of the manuscript.

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