Effectiveness of Community Health Workers in the Care of People with Hypertension

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Background: The contributions of community health workers (CHWs) in the delivery of culturally relevant programs for hypertension control have been studied since the 1970s. This systematic review examines the effectiveness of CHWs in supporting the care of people with hypertension.

Methods: Computerized searches were conducted of multiple bibliographic electronic databases from their inception until May 2006. No restrictions were applied for language or study design, and studies were restricted to those that reported at least one outcome among participants.

Results: Fourteen studies were identified, including eight randomized controlled trials (RCTs). Many of the studies focused on poor, urban African Americans. Significant improvements in controlling blood pressure were reported in seven of the eight RCTs. Several studies reported significant improvements in participants' self-management behaviors, including appointment keeping and adherence to antihypertensive medications. Four studies reported positive changes in healthcare utilization and in systems outcomes. Two of the RCTs showed significant improvements in other patient outcomes, such as changes in heart mass and risk of CVD.

Conclusions: Community health workers may have an important impact on the self-management of hypertension. Programs involving CHWs as multidisciplinary team members hold promise, particularly for diverse racial/ethnic populations that are under-served.
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Introduction

Uncontrolled high blood pressure (BP), a key risk factor for heart disease, stroke, and renal disease, is a significant public health problem.[1,2] Nearly one in three adult Americans are hypertensive (BP ≥140 mmHg [systolic] or ≥90 mmHg [diastolic]); another 59 million are prehypertensive (BP 120 to 139 mmHg [systolic] or 80 to 89 mmHg [diastolic]).[3] Only about 30% of people who are diagnosed with hypertension have their BP under control.[2,4] Even worse, of the estimated 20.8 million people in the United States with diabetes, just 12% have their BP under control (BP<130/80 mmHg).[5,6]

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Rates of hypertension control remain low for a variety of reasons, including inadequate intensity of treatment and the failure of providers to comply with evidence-based guidelines.[7–9] Poor and high-risk minority populations face additional barriers, including health beliefs and values (e.g., "medications only need to be taken as needed"), insufficient access to culturally sensitive care (or any care), and lack of knowledge about hypertension and how to treat or screen for this problem, and an absence of self-management skills.[8,9]

In response to many of these barriers and to improve health outcomes in the community, the involvement of trained laypeople, known as community health workers (CHWs), has gained momentum.[8,10–16] CHWs are also known as lay health advisors, community health representatives, promotores de salud, patient navigators, and outreach workers.[8,13] They are important advocates who can bridge cultural and social gaps between providers of health and social services and the community members they seek to serve.[8,13] CHWs provide culturally relevant and appropriate education, counseling, and social support, and they may provide clinical services such as measuring BP.[8] They can facilitate access to care, promote continuity of care, make the use

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of health care more appropriate, facilitate the adoption of self-care skills for disease management, and enhance compliance with treatment regimens.[8,10–14,17]

The purpose of this systematic review was to examine the effectiveness of CHWs in the care of people with hypertension. In particular, the aim was to determine whether programs involving CHWs increase the number of people with sustained control of their BP.

Methods

This systematic review was part of a larger review examining the effectiveness of CHWs in the care of people with chronic diseases, and was performed[12] using the methodology outlined by the Cochrane Collaboration.[18] A full description of the review methodology was described in an earlier report.[12] With the guidance of an information specialist, the authors searched seven electronic databases from their inception (in parentheses) to May 2006: MEDLINE (1966), Educational Resources Information Center (ERIC) (1966), Cumulative Index to Nursing and Allied Health (CINAHL) (1982), Sociological Abstracts (1963), Chronic Disease Prevention Databases (1977), PsychINFO (1967), and Web of Science (1981).

Community health workers were broadly defined as any health workers who carried out functions related to healthcare delivery, were trained as part of an intervention, had no formal paraprofessional or professional designation, and had a relationship with the community being served. The included studies reported at least one outcome among participants. Studies that focused exclusively on outcomes among CHWs and those involving peers who merely led support groups were not included in this review.

There were no restrictions on language of publication, geographic location (country), or study design. Before-and-after or cohort studies were included, as they provide useful data pertaining to process outcomes such as the satisfaction of participants with CHW services.

Published abstracts were excluded because they generally do not provide an adequate description of interventions, and thus the quality of the study was difficult to assess. Dissertations were also excluded, as the full text was rarely available. The authors noted that numerous organizations (e.g., health departments, healthcare providers, and community-based programs) include CHWs in their teams but have not published evaluations of their programs. Unpublished data were not considered.

Relevant data from included studies were extracted by one author (FMC) and verified by a second (JNB) using a standardized abstraction template. Any discrepancies were resolved through consensus. Quantitative data are presented as mean values, with standard deviations (SD), percentages, or median values.

Results

Characteristics of the Studies and the Participants

Fourteen primary studies[19–32] with six companion papers[33–38] were identified that examined the effects of an intervention involving CHWs on the care of people with hypertension (Figure 1) (Table 1). The companion papers reported study characteristics or early follow-up data of a longer study, and their citations are included with the citations of the primary study that reported final outcomes. The 14 primary studies, which were published between 1983 and 2005, included eight randomized controlled trials (RCTs),[19,25,26,28–32] three studies with a before-and-after design,[22,24,27] one study with nonrandomized allocation of treatment and comparison groups,[21] one time series,[20] and one survey[23] (Table 1). Sample size varied widely (range 20[27] to 1367,[31] and one community of 56,000 members[29]). The median follow-up interval was 24 months for the eight RCTs (range 12 to 96 months) and 21 months (range 12 to 24 months) for the six studies with nonrandomized designs.

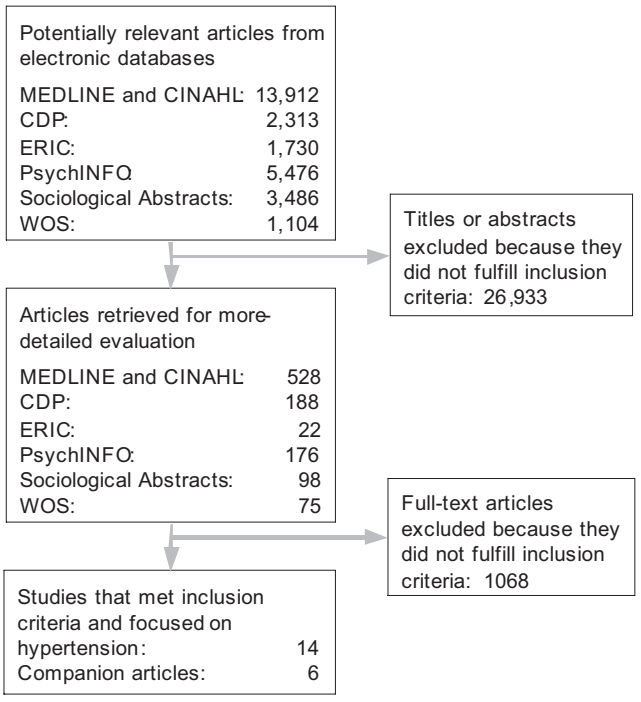

Figure 1. Systematic review flow diagram. CDP, Chronic Disease Prevention Database; CINAHL®, Nursing and Allied Health database; ERIC™, Educational Resources Information Center Database; WOS, Web of Science.

Participants were middle-aged (range 39.0[26] to 57.4[22] years), and 45.4% were female (range: 27.8%[28] to 78.0%[22]). All studies but one[22] focused exclusively on controlling hypertension. The frequency of participants' contact with the CHW varied from once a week[21,24] to once a year.[32]

Interventions were primarily targeted to minority populations (most commonly African Americans). Four studies focused exclusively on African American males in Baltimore,[21,25,26,29] many of whom had high-risk behaviors or situations (e.g., alcoholism, use of illicit drugs, unemployment, no insurance, high rate of incarceration).

All of the studies were conducted in the U.S.; additional articles were identified in both developed and developing countries but contained no data on outcomes. Interventions were conducted in healthcare settings,[21,27] community settings,[23,24,26,28,29] and a combination of these settings.[19,20,22,25,30–32] Community settings were generally participants' homes, but CHWs also conducted community outreach in places such as churches, community centers, food banks, and local jails.

Community health workers were either the sole focus of the intervention under study[21–24,26–29] or one component of a multicomponent intervention[31,32] or team.[19,20,25,30]

The Characteristics, Roles, and Training of CHWs

The characteristics of CHWs were not as well described as those of the study participants. The CHWs, predominantly women, were recruited from the community, and resembled the participants in race/ethnicity and socioeconomic background (where this information was reported). The number of CHWs actively providing services to participants ranged from one to 38. Two studies reported age of the CHWs: in one report mean age was 59 years[21] and in the other age ranged from 30 to 45 years.[22] None of the CHWs had previous work experience in health care, but at least three studies indicated the CHWs had previous experience in community service,[21,22,27] and one study recruited CHWs who had knowledge of social networks (e.g., social relationships among people who know each other) and organizations in the community.[24]

The roles and duties of CHWs were consistent across the studies and reflected the common objective of BP control. A major role was to provide health education and information to patients and families on behavioral risk factors for hypertension, recommended changes in lifestyle, protocols for treatment and medication, the importance of adherence to treatments, and ways to reduce barriers to compliance with treatment.[19–22,24–32]

A second major role was to ensure that participants received services necessary for BP control, including assistance with insurance matters, referrals, and maintaining services necessary for BP control. Many CHWs offered instrumental support, such as arranging for transportation to medical appointments.[20–22,24–32]

A third role was to provide direct services to participants, including measuring and monitoring BP,[20,21,27–30,32] and a fourth was to provide social support to the participants and their family members by talking to and listening to them, motivating them, reducing their isolation, and leading self-help groups.[19,22,24,31]

Finally, CHWs served as mediators between participants and the healthcare and social service systems. These workers focused on management of healthcare utilization (e.g., making appropriate use of the emergency room), and they provided referrals to social services, additional information on community resources,[19,28,32] and translation services.[32]

The content of the training programs for the CHWs was generally consistent across studies that provided this information[21,25,27,28,30–32] and included the following: measuring BP and pulse rate; monitoring BP (following American Heart Association [AHA] guidelines in effect during the period of the study) and following up in this area; and providing education on high BP, healthy lifestyles, strategies for adherence to treatment, and community resources. CHWs trained in Baltimore were certified by the Johns Hopkins University and the State Health Department of Maryland.[21] Several studies trained their CHWs according to the AHA guidelines, and one[28] used the American Red Cross to certify CHWs (another study did not identify the certifying agency).[32] The duration of training (when reported) ranged from 30[21] to 100[28] hours; in two other studies it lasted an unknown number of hours over 3 weeks[24] or 3 months.[30] In many studies nurses or physicians trained and supervised the CHWs.[19–23,25,27,30]

Outcomes of the Studies

The outcomes of the CHW interventions are reported in Table 2. Given the heterogeneity of the populations, settings, interventions, and outcomes, a quantitative synthesis (meta-analysis) was not possible, and thus the data are presented and synthesized in a narrative fashion.

Positive behavioral changes were noted in nine of the ten studies measuring such changes (Table 2). Four RCTs[28,29,31,32] and one comparison study[21] reported significant improvements in appointment keeping that ranged from 19% to 39% (relative changes) over 12 to 24 months. One RCT did not show any differences in this outcome at 12 months.[26]

Five studies[19,20,25,27,31] focused on adherence to medications. Two of them, both RCTs,[19,31] noted significant improvement in the intervention group (in which CHWs were used) when compared with the control group (between-group differences ranged from 8% to 14% at follow-up from 12 to 60 months). Another study, also an RCT,[25] found 26% greater compliance among patients receiving intense CHW interventions. A before-and-after study[27] found a 17% significant improvement in adherence to medication with counseling by CHWs, and a time-series study noted that 86% of CHW-assigned patients were on BP medications.[20]

Of the ten studies that examined the effects of CHWs on BP control, nine reported positive improvements, including six RCTs,[19,25,29–32] one time-series study,[20] and two before-and-after studies[24,27] (Table 2). The RCTs found differences between CHW and control

Table 1. Study characteristics

Author (year)[ref] Study design/ follow-up (mo)	Client, *n*/ CHW, (*n*)	Quality (attrition) Clients (%); CHWs (%)	Recruitment of participants	Participants		
				Age, years (mean) [SD]	Race/ ethnicity; (% female)	Education, years/ HS; income
Becker (2005)[19] RCT (12)	364 (1)	27; NA	Siblings (30–59 yr) of black probands hospitalized for CHD events. Siblings had no history of CAD, chronic glucocorticosteroid therapy, autoimmune disease, current cancer therapy, immediate life-threatening comorbidity. Randomized to CBC or EPC group	47.7	100% AA; (63.3)	12.8 (mean); 78.6% employed
Bloom (1987)[20] Time series (24)	262 (2)	18 (calculated); NR	Randomly selected from households, health fairs	Range: <40: 5.9% M, 5.2% F; 40–59: 6.5% M, 15.7% F; ≥60: 10.4% M, 12.5% F	AA and non-AAs; (55.8)	NR; NR
Bone (1989)[21] Comparison group (24)	800 (6)	NR; NR	HTN patients referred to primary care clinic from the emergency department	34 (median)	85% AA; (53.0)	NR; 50% public assistance
Fedder (2003)[22] Before-and-after (12)	117 (68 trained, 38 provided services)	NR; 56 (38/68 provided services)	Medicaid discharge rolls and diabetes care program	57.4 [12.0]	AA; (78.0)	NR; NR
Felix-Aaron (2002)[23] cross-sectional	84 (NR)	NA; NA	Randomly selected, received CHW services	53.5	100% AA; (40.5)	44.0% at least HS education; 28.6% full/part-time employment
Frate (1985)[24,33] Before and after (12, 14, 18)	229 (NR)	NR; NR	Randomly selected, community survey	NR	~50% white, 50% AA; (NR)	NR; (1979) per capita—$5839 white, $2468 AA
Hill (2003)[25] RCT (12, 24, 36)	309 (1)	25; NR	Medical records, advertisements, word of mouth	41 [6]	AA; (0.0)	>60% HS diploma or equivalent; 27% part-time or full-time, 71% annual income<$10,000
Hill (1999)[26] RCT (12)	204 (1)	23; NR	Medical records, advertisements, word of mouth.	39 (range, 22–49)	100% AA; (0.0)	NR; NR
Hovell (1984)[27] Before-and-after (NR)	20 (NR)	NR; NR	Volunteers from HMO	53	80% white, 10% AA, 10% Asian; (35.0)	NR; NR
Krieger (1999)[28] RCT (3)	421 (14)	6; NR	Low-income community settings	Range, 18–≥65	79.1% AA, 20.9% white; (27.8)	24.3%<HS, 40.7% HS, 35.0% >HS; 66.3% income ≤federal poverty level

Table 1. (*continued across*)

	CHWs				
Setting	**Training**	**Race/ ethnicity**	**Education, experience**	**Supervision**	**Duties**
Urban	Completed YMCA standard training program for volunteers and basic life support training	AA	NR	Nurse practitioner	Counseled on filling and using prescriptions, shopping for and preparing healthy foods, accessing an exercise facility, and smoking cessation; negotiated decisions about participant care
Community-based health care and home visit	By project staff to work with HTN patients	Same as clients	HS; 2 had previous community experience	General direction by staff physician	Facilitated adherence to taking medications and appointment keeping, provided social support, BP measurement, educated on low-salt diet, referrals; arranged transportation
Emergency department	30 hours on hypertension, taking BP measurements	NR	Some previous experience. No work in health-related areas	Community health nurse or educator	Provided high-BP screening, telephone appointment reminders, educational counseling, and referral
Health care and home visits	NR	85% AA	<12 yr	Close supervision, bi-weekly meetings	Provided in-home visits, weekly phone calls & referrals; monitored signs of complications; provided social support; assisted with medical eligibility
Baltimore (inner city)	NR	NR	NR	Nurses	Provided education, monitoring, social support
Rural community-based setting (5 counties)	3 weeks on BP measurement with certification	NR	NR	NR	(Group 1) Health counselors to HTN patients, focused on compliance with both pharmacologic and nonpharmacologic therapy. (Group 2) Developed and led family and church self-help groups
Outpatient center, and at least one annual home visit	NR	NR	NR (CHWs part of health care team in the program)	Nurse and physician	More than one annual home visit, support on health matters, referrals to social services (including job training and locating housing)
Emergency department	NR	100% AA	NR	NR	Recruited participants, tracked enrollees, made home visits
Hospital	BP and adherence measurement, interviewing, and counseling by a nurse and psychologist in three 2-hour sessions	NR	HS graduates, and college students	Nurse	(Intervention group) Measured BP, followed missed appointments by phone, referrals, education
Community settings	100 hours training in hypertension, CVD, stress, certified in BP measurement	86% AA	NR	NR	Provided education, BP measurement, referrals, transportation, child care, appointment reminders, follow-up on visits

(*continued on next two pages*)

Table 1. (*continued*)

Author (year)[ref] Study design/ follow-up (mo)	Client, *n*/ CHW, (*n*)	Quality (attrition) Clients (%); CHWs (%)	Recruitment of participants	Participants: Age, years (mean) [SD]	Participants: Race/ ethnicity; (% female)	Participants: Education, years/ HS; income
Levine (1990)[29,36,37] RCT (96)	56,000 community; 1100 young males (1)	NR; NR	Emergency room/community	53 (median)	AA; (NR)	10 yr (mean), YBM=10 yr, for community=7 yr; 40% unemployment, poor
Levine (2003)[30] RCT (40)	789 (NR)	0; NR	Randomly assigned to > or < intensive intervention	54.2	AA; (61.9)	57.8%<HS, 39.8% HS/some college, 2.4% college graduate; annual family income: 7.5% (none), 58.8% (<$10,000), 9.6% ($10,000–$14,999), 10.0% (>$15,000), 7.7% (refused), 6.9% don't know
Morisky (1985)[31,34,35,38] RCT (multifactorial) (12, 24, 60)	400 (1)	0; NR	Randomly selected from clinic settings	54 (median)	91% AA; (70.0)	8 yr schooling (mean); $4250 (median)
Morisky (2002)[32] RCT (6, 12)	1367 (NR)	NR; NR	Randomly selected from clinic settings	53.5	77% AA, 21% Hispanic (self-identified); (59.2)	49% <HS, 40% HS diploma; >50% (<$5000/yr), 37% ($5000–$14,000/yr)

groups ranging from 4% to 46% over 6 to 24 months. In one of these RCTs,[30] patients receiving one CHW home visit and those receiving six such visits did equally well in achieving significant[30] BP control over a 40-month period. In another of these four RCTs, the participants in the CHW group were twice as likely to achieve BP goals as those in the comparison group.[19] In one of the two before-and-after studies, monitoring of BP by CHWs was associated with a significant decrease in diastolic BP of 7 mmHg[27]; in the other, >90% of the patients had their BP under control at 12 months and 79% to 90% had it under control at 18 months.[24] Finally, one RCT did not find any difference between CHW and control groups at 12 months.[26]

Two studies tried to distinguish the effect of CHWs from the effects of other team members or of other educational components. In one, a time-series study by Bloom et al.,[20] the authors found that patients assigned to either CHWs or nurse practitioners (NPs) had their BP under control in equal numbers at 24 months, but those assigned to CHWs were more likely to be on medications than those assigned to NPs (86% vs 70%). In the other study, in which Morisky et al.[31,34,35,38] used a multicomponent, mulifactorial design (a strong design that allows for both the control of threats to internal validity and the identification of the effects of separate components of the study), one intervention arm tested a single home visit by a CHW to educate family members and promote their support for encouraging positive behavioral changes in hypertensive patients (n=400). At 12 months, this strategy was as effective in reducing BP as were the other treatment strategies: a 15-minute educational interview in the clinic and a support group led by a social worker.[34] Versus the control group, participants in the CHW intervention group had improved BP at 12 months ($p<0.01$)[34] and at the 5-year follow-up ($p<0.01$).[31] At the 2- and 5-year follow-ups, BP control, appointment keeping, and weight control were significantly improved or maintained only by patients in the CHW intervention.[31] Additionally, Morisky et al.[38] reported a 17.6% (standard error 7.1 percentage points) 5-year mortality rate for the CHW arm, versus 30.2% (standard error 8.3 percentage points) for the control group. Morisky et al.[38] also found that there were strong correlations among adherence to medication, keeping appointments, and BP control through a 5-year follow-up period in the CHW group.

Table 1. (*continued across*)

	CHWs				
Setting	**Training**	**Race/ ethnicity**	**Education, experience**	**Supervision**	**Duties**
Urban	BP screening, educational counseling, monitoring, follow-up, and outreach services	AA	No background in health care	NR	Provided BP screening, educational counseling, monitoring, follow-up, and outreach services
Urban	3 mo BP measurement standards, certified by Johns Hopkins University and MD State Health Department	AA	NR	Nurses and community-based advisory board	Surveyed households, provided community outreach and patient education, linked people to care, monitored and coordinated other services necessary for BP control (e.g., obtaining insurance), transportation
Urban	NR	AA	NR	NR	Educated patients and family members/other peers of patients in keeping patients compliant with appointments, adherence to medication, and self-care
Urban	Trained and certified in BP measurement and monitoring; interview skills, dealing with patient barriers to treatment and medication protocols	NR	NR	NR	Educated on lifestyle characteristics (e.g., diet, exercise), conducted home visits, interviews, corrected misconceptions, reinforced treatment adherence, and involved family in treatment regimens

AA, African American; BP, blood pressure; CAD, coronary artery disease; CBC, community-based care; CHW, community health worker; CHD, coronary heart disease; EPC, enhanced primary care; F, female; HMO, health maintenance organization; HS, high school; M, male; mo, months; NA, not available; NR, not reported; RCT, randomized controlled trial; YBM, young black men; yr, years.

Significant improvements in other outcomes were noted; for example, Hill et al.[25] found a decrease in left ventricular mass (at 36 months) among African-American male patients receiving CHW visits and major support on health issues. Becker et al.[19] reported significant (beneficial) changes in the distribution of the Framingham risk score for coronary risk events for participants that were assigned to a CHW group. Becker et al.[19] suggested that the outstanding results of the CHW group may well have been mediated by the intervention CHW who facilitated the navigation of systems necessary to make changes in risk factors (e.g., by showing how to shop and prepare healthy foods, access exercise facilities, and fill prescriptions) and gained the trust of the participants. Two RCTs,[25,28] one comparison study,[21] and one before-and-after study[22] reported improvements in healthcare utilization and systems outcomes, including more-appropriate use of the emergency department,[21,22] reduced admissions to the hospital through the emergency room,[25] cost savings,[22] a larger proportion of participants having a physician or nurse for hypertension care,[25,28] a higher number of appropriate follow-up visits,[25] greater responsiveness of providers to patients' needs,[21] and increased participation of CHWs in planning meetings.[21] Two studies that addressed patient satisfaction found that the competency of the CHWs and the social support they provided were very important to the participants[23,32] (Table 2). Finally, Morisky et al.[32] noted that both the availability of social support and satisfaction with it were positively related to treatment compliance.

Additionally, it is notable that significant results were reported by studies using the nurse or an NP–CHW team approach.[19–21,28]

Quality of the Studies

The quality of the studies included in this review varied. Important characteristics of participants were reported in most cases, but descriptions of the characteristics of the CHWs were often incomplete. Among the eight

Table 2. Hypertension-related outcomes

Author (year)[ref]	Participant satisfaction	Participant awareness and behavior outcomes and satisfaction	Physiologic measures and health outcomes	Healthcare system outcomes
Becker (2005)[19]	NR	% taking antihypertensive agents (↑): CBC=17, EPC=9 ($p<0.0001$); % taking lipid-lowering agents (↑): CBC=32, EPC=7 ($p<0.0001$); % current smokers (↓): CBC=−6, EPC=−3 ($p<0.0001$); % used card to fill prescriptions: CBC=74, EPC=34 ($p<0.0001$); % participation in free YMCA exercise—CBC: 20, EPC:0 ($p<0.0001$). Modest, nonsignificant improvement of diet and exercise in CBC group	CBC group was 2 times more likely to achieve blood pressure (95% CI=1.4–3.9) and LDL cholesterol goals (95% CI=1.1–4.2); ↓ %FRS for total CHD: [CBC vs EPC=25.5 vs 3.3 ($p<0.0001$)]; ↓ % FRS CHD risk among nondiabetic siblings: [CBC vs EPC=27.4 vs 2.3 ($p<0.0001$)]; ↓ CHD global health risk for CBC compared to no ↓ in EPC ($p<0.0001$)	
Bloom (1987)[20]	NR	Those assigned to CHWs were more frequently on medications than those assigned to NP (86% vs 70%)	At T1 58.4% and at T3 78.3% had controlled BP. Mean SBP and DBP difference 7.7 mmHg (T=5.06, $p<0.001$); 2.84 mmHg (T=3.65, $p<0.001$). Of 40% improvement, 10% was attributed to physician care, 30% to counseling	NR
Bone (1989)[21]	NR	Significant improvement in CHW (19%, $p<0.001$) group at follow-up >2 yr. Patients not keeping follow-up recontacted with 7% improvement ($p<0.001$). Total improvement in appointment keeping 26%	NR	↑ provider responsiveness to patients' needs; ↑ BP service hours and ↓ fees for BP follow-up visits; CHWs included in the emergency department staff's annual planning meetings
Fedder (2003)[22]	NR	NR	NR	Healthcare utilization: ↓ ER visits 38% (p value NR); ↓ admissions through the ER 53% ($p=0.02$); no significant relationship between age, gender, number of CHW contacts, and outcomes
Felix-Aaron (2002)[23]		Aspects of CHW care rated important: CHW knows job, keeps client alive, gives information on HBP, shows respect, speaks understandably, pays attention	NR	NR
Frate (1985)[24,33]	NR	NR	At 12 mo, 92% ($n=222$) of clients managed by CHWs achieved BP ctrl ($p<0.0001$); 90% ($n=211$) clients achieved BP ctrl in 16 CHW-led self-help groups. At 18 mo, significant BP ctrl ($p<0.0001$) for three CHW interventions	Healthcare utilization: at 12 mo >300 people who were unaware of being HTN or uncontrolled who were enrolled

Table 2. (*continued*)

Author (year)[ref]	Participant satisfaction	Participant awareness and behavior outcomes and satisfaction	Physiologic measures and health outcomes	Healthcare system outcomes
Hill (2003)[25]	NR	For HTN meds compliance, CHW group and ctrl group: significant improvement ($p<0.001$). CHW group 26% higher rate of improvement in medication compliance	At 36 mo, controlled BP including CHW group vs ctrl group 44% vs 31% ($p=0.045$). Mean SBP/DBP change: CHW group was −7.5/−10.1 mmHg, ctrl group +3.4/−3.7 mmHg. Left ventricular mass in CHW group vs ctrl group was 274 g vs 311 g ($p=0.004$)	Proportion of men reporting having a physician or nurse for HTN care among MI ↑ ($p<0.05$).
Hill (1999)[26]	NR	77% completed follow-up. Follow-up appointments not significantly different between groups	At 12-mo follow-up, SBP and DBP were not statistically different from zero for both CHW (I) and ctrl (UC) groups	Entry into care and remaining in care remained at low rates
Hovell (1984)[27]	NR	CHW counseling ↑ mean medication adherence (69% to 84%)	Monitoring by CHWs associated with change (−10 mmHg in SBP and −7 mmHg in DBP ($p<0.05$). Decrease in DBP significant ($p<0.01$)	NR
Krieger (1999)[28]	NR	Appointment keeping: ↑ in CHW group 39.4% vs usual care [95% CI=14%–71%; $p=0.001$)]	NR	Follow-up: μ in IG by 39.4% [95% CI=14%–71%, $p=0.001$]
Levine (1990)[29,36,37]	NR	Community HTN awareness: ↑ from 65% to 80% ($p<0.01$); for YBM HBP awareness: ↑ 44% to 65% ($p<0.05$)	BP ctrl YBM in community 12% to 40% ($p<0.01$); $p<0.05$). 5-yr community results (combined IG including CHW) ↑ BP ctrl (38% to 79%); HTN- related hospitalization: ↓ 30%; mortality from uncontrolled HTN ↓ 65% ($p<0.01$)	NR
Levine (2003)[30]	NR	NR	BP ctrl: both CHW (MI) (16% to 36%) and ctrl (LI) (18% to 34%) ($p<0.01$)	NR
Morisky (1985)[31,34,35,38]	NR	Appointment keeping (2-yr follow-up) in CHW group significantly higher vs ctrls ($p<0.001$); ↑ medication compliance (53% with mean compliance score of 0.876) vs ctrls (39%, mean compliance score of 1.932) $t=3.7$; $p<0.01$) Appointment keeping (5-yr follow-up) ↑ in IG compared to CG (0.95 vs 0.83; $p\leq0.01$); meds compliance 53% CHW group vs 40% in CG	For CHW group vs ctrl group, all-cause life table mortality rate per 100=12.9 vs 30.2 ($p<0.05$); HTN-related mortality rate per 100=8.9 vs 19.0 ($p<0.01$); deviation from ideal WT significant ↑ in all IG (5 yr); for CHW IG, BP ctrl ↑ 26% vs 51% CG ($p<0.001$). For WT ↑ 22% CHW group vs ctrls; 68% vs 46% were within 4.5 kg of their ideal WT ($p<0.001$)	NR
Morisky (2002)[32]	Social support and satisfaction with social support positively related to compliance ($r=-0.11$, $p<0.004$)	Hispanic patients had significantly higher rates of appointment keeping compared to AAs at 6 mo (56% vs 49%) and at 12 mo (54% vs 46%) follow-ups ($p\leq0.01$)	CHW counseling group (6 mo) ↑ 13% BP ctrl (maintained at 12 mo) with 46% under ctrl ($p\leq0.01$) (12 mo). Hispanic patients significantly higher proportion BP ctrl vs AA and other ethnicities ($p<0.05$)	NR

AA, African Americans; CBC, community-based care; CG, control group; CHD, coronary heart disease; CHW, community health worker; CI, confidence interval; ctrl, control; DBP, diastolic blood pressure; EPC, enhanced primary care; ER, emergency room; FRS, Framingham risk factor; HBP, high blood pressure; HTN, hypertension/hypertensive; I, intervention; LDL, low-density lipoprotein; LI, less intensive; MI, more intensive; mo, months; NP, nurse practitioner; NR, not reported; SBP, systolic blood pressure; T, time; T1, Time 1; T3, Time 3; UC, usual care; WT, weight; yr, years; YBM, young black males.

RCTs, only one[25] reported blinding of the assessor. Randomization methods were reported in only six studies,[19,25,28,30–32] and concealment of allocation was reported in just one.[25] On the other hand, most studies involving two or more groups described comparability of the comparison groups at baseline.[19,25–28,30–32] Participants' attrition from the study was reported in seven studies,[19,20,25,26,28,30,31] and ranged from 5.7% (at 3 months)[28] to 40.3% (at 5 years).[31]

Discussion

In this review the authors identified an emerging literature on the effectiveness of CHWs in the care of people with hypertension. Despite heterogeneity in the study designs, amount of training, goals of the interventions, and settings, the authors found a consistent trend in positive outcomes for BP along with improvements in mortality, healthcare utilization, and systems outcomes.

Nemcek et al.[9] identified three outcomes relevant to culturally competent CHW care: improved healthcare utilization, risk reduction, and satisfaction with CHW care. Various studies in this review provide support for the idea that these outcomes can be attained in the context of a supportive relationship with participants. CHWs facilitated appropriate use of health care and self-management behavior (i.e., by improving adherence to appointment keeping and hypertension treatment), improved BP control, and other positive health outcomes. Not only did seven of eight high-quality RCTs report positive outcomes, but so also did all six of the studies with less rigorous designs, demonstrating that less costly, practice-based interventions can bring about important changes for community members.

The roles of patient education and counseling and the provision of various services that the authors found in this review are consistent with those identified for CHWs in various other fields, including diabetes.[12,13] Some of the roles and the successes achieved appear to be similar to those of nurses who have provided educational interventions aimed at hypertension control,[39–42] and suggest an efficient strategy for bringing about enhanced treatment and sustained BP control for targeted racially or ethnically diverse, high-risk populations. Allen and Scott[43] are also in agreement that studies involving multidisciplinary teams that include nurses and CHWs appear to be a successful strategy for improving BP outcomes. While trained laypeople cannot perform in the same capacity as professional nurses and health educators, with appropriate training and supervision they can successfully contribute to the care of community members with hypertension, as demonstrated by many of the studies reviewed.

Limitations

This review has several important limitations. First, the reporting and assessment of each intervention study was limited to published data; in many cases, details of the studies were not described. This was particularly true for the education of the CHWs, their training, experience, and supervision, as well as their attrition rates. Future studies should better describe these characteristics.

Second, because the studies reviewed had heterogeneous designs, variable quality, potential threats to internal validity, and unknown external validity, the applicability of these results to other settings or to broader populations cannot be predicted. Although most participants were members of underserved communities in the United States, participants were generally selected by either the researcher or provider or were self-selected.

Factors for Success of Interventions Involving CHWs

Numerous factors appear to have contributed to the success of interventions to control hypertension (HTN) that involved CHWs: the innate helping qualities of the CHWs; the recruitment of CHWs who shared demographic and cultural characteristics and were drawn from the same communities as the participants; training and supervision by nurses, physicians, and health educators; and the building of community capacity that resulted in a community of care for people with hypertension. The results confirm one of the shared strengths of CHWs: the ability to effectively work with community members (often through social networks), regardless of the setting.[13] These observations are supported by the Institute of Medicine,[44] which has recognized the value of CHWs as community resources with the potential to serve various roles, and which recommends supporting CHWs as members of comprehensive, multidisciplinary teams. CHWs who worked in the community at large were able to identify with their clients and provide culturally appropriate education and services (especially to community members lacking health insurance and access to mechanisms for measuring their BP or medicines to treat it if elevated).[25,28] The strong multifactorial design of one multicomponent intervention made it possible to isolate the effect of CHWs on patient outcomes: this RCT[31,34] and one other RCT[28] study were included in a recent review[45] on treatment for hypertension and, on the basis of rigorous criteria, recognized as effective interventions. There was also a time-series study[20] that attempted to distinguish the effect of CHWs from that of other team members.

Motivating adherence to healthy lifestyles and treatment regimens is a major problem for patients with

high blood pressure. The authors found that the ongoing social support given by CHWs had a positive effect on study participants. Relationships between social supports, social networks, and health outcomes are basic concepts in health education and applies to the CHW model.[46] At least two of the studies in this review reported that the social support and building of trust provided by CHWs were instrumental to the success of their projects.[19,31]

The number of positive outcomes in high-risk populations is encouraging. For example, in four studies in this review that focused exclusively on African-American men living in inner-city Baltimore, Bone and Mamon,[21] Hill et al.,[25,26] and Levine and Bone[29] found that significantly more of the men remained in care after being recruited and educated by CHWs. Becker et al.[19] suggested that the significant improvements seen in their high-risk African-American patients in Baltimore, may have been partially mediated by the efforts of the CHW, who was trusted by the study participants and who served as a culturally sensitive system navigator.

Of all the CHW studies reviewed, only one did not show any improvements.[26] This study was able to recruit participants but lost about 25% of both its intervention and control groups to incarceration, death, or moving to another area. Hill et al.,[25] however, followed this study with an enhanced approach that included a physician–nurse–CHW team. With CHWs providing intensive support to the men, the team approach yielded significantly improved outcomes at the 36-month follow-up.

Future Directions for Research and Practice

Numerous gaps in research about CHWs remain, such as the need for testing the applicability of the CHW model in various populations, specifying the system supports needed by CHWs, evaluating patient and provider satisfaction, and assessing optimal performance of CHWs.[8,12] Various aspects of CHW programs related to policy (e.g., new reimbursement strategies for services and integration into healthcare practice), the issue of credentialing, and the question of sustainability need to be addressed, and these are elaborated elsewhere.[8] Only two studies in this review shed light on participants' satisfaction with CHW service[23,32]; clearly, measures of patients' expectations and satisfaction need to be incorporated into future studies. This can be accomplished through the use of functional status tools that measure expectations and satisfaction.[47] Another area that needs to be examined is the perceived quality of life of participants.

There are still no data on the cost effectiveness of CHW programs. This deficit may be due to methodologic shortcomings as well as an inability to capture some of the effects of CHW programs using conventional approaches for economic evaluation.[48] For example, how does one place a monetary value on the characteristics and actions of laypeople from the community who, in many cases, volunteer to help others?

Lessons learned from research need to be translated into useful guidelines, protocols, and recommendations for practitioners if we are to implement and sustain CHW models to reduce disparities in hypertension. Researchers need to identify the successful components of CHW programs to improve their transferability to various populations. Zuvekas and Nolan[49] recommend allowing CHWs to enter their services into automated patient database systems, a practice that would help in understanding what CHWs specifically contribute and in measuring the results of interventions.

Specific competencies and skills for CHWs should be identified, which would be based on those identified for the general public health workforce.[50] A competency might be knowledge of techniques for managing BP, and specific skills could be the ability to accurately take a BP, to show community members how to take their own BP measurements correctly on a home device, how to record BP measurements, and when and how to report the measurements to healthcare providers. Many of the studies in this review relied on the AHA's training guide for measuring BP[51] and on certifying CHWs on BP measurement, but we do not know how other skills were assessed. Guidelines are needed on how often nurses, physicians, or health educators and other professionals need to reinforce and evaluate the competencies and skills of CHWs.

To meet the training needs of practitioners and researchers in cardiovascular health and disease, federal agencies have produced various curricula. These resources include Your Heart, Your Life/Salud para su Corazón[52] (National Heart, Lung, and Blood Institute [NHLBI]); Honoring the Gift of Heart Health[53] (NHLBI and Indian Health Services); and a comprehensive Community Health Workers Heart Disease and Stroke Sourcebook[54] (Centers for Disease Control and Prevention). These curricula are presented in a common format and provide a standardized, low-literacy, CHW-friendly approach to training CHWs and they can help in assessing contributions of the CHWs after they have been trained. These curricula can be used by community organizations and colleges that offer training; by programs providing community education, screening, and follow-up; and by programs offering patient education classes led by CHWs.

A new role for CHWs may be in programs that plan for disasters, and this role warrants attention by practitioners and researchers. Following the hurricanes in 2005, the Florida Department of Health reported that the greatest need expressed by community members was access to medicines for high BP and for insulin. The department has developed a pilot program using

CHWs to assess which members of the communities would need vital medicines following a disaster.[55]

Conclusion

Community health workers have the potential to contribute to self-management of hypertension and to optimal control of BP by providing social support, education, outreach, and enhanced case management. As community-change agents and trusted peers, CHWs appear to be able to motivate, facilitate, and help empower community members to maintain required behaviors that contribute to their own continuity of care and improved health outcomes. Findings from this review can help community health clinics and other programs as they consider integrating CHWs into the chronic care model[56,57] of practice.

The findings and conclusions in this paper are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention.

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References

1. Joint National Committee. The sixth report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. Arch Intern Med 1997;157:2413–46.
2. Chobanian AV, Bakris GL, Black HR, et al. The seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 report. JAMA 2003;21;289:2560–72.
3. American Heart Association. Heart disease and stroke statistics—2005 update. www.americanheart.org.
4. Glover MJ, Greenlund KJ, Ayala C. Racial/ethnic disparities in prevalence, treatment, and control of hypertension—United States, 1999–2002. Morb Moral Wkly Rep MMWR 2005 14;54:7–9.
5. Douglas J. Improving cardiovascular health outcomes through the use of evidence-based medicine. Ethn Dis 2005;5(suppl 2):23–26.
6. National Centers for Chronic Disease Prevention and Health Promotion. National diabetes fact sheet: national estimates on diabetes, 2005. Available at: www.cdc.gov/diabetes/pubs/pdf/ndfs_2005.
7. Cooper R, Cutler J, Svigne-Nickens P, et al. Trends and disparities in coronary heart disease, stroke, and other cardiovascular diseases in the United States: findings of the national conference on cardiovascular disease prevention. Circulation 2000;102:3137–47.
8. Brownstein JN, Bone LR, Dennsion CR, Hill MN, Miyoung KT, Levine DM. Community health workers as interventionists in the prevention and control of heart disease and stroke. Am J Prev Med 2005;29(suppl 1):125–33.
9. Nemcek MA, Sabatier R. State of evaluation: community health workers. Public Health Nurs 2003;20:260–70.
10. Brandeis University. Evidence report and evidence-based recommendations: cancer prevention and treatment demonstration for ethnic and racial minorities, 2003. Available at: www.cms.hhs.gov/demoprojectsevalrpts/downloads/cptd_brandeis_report.pdf. Schneider Institute for Health Policy and the Heller School for Social Policy and Management, Brandeis University, Contract No. 500-00-0031. Baltimore: Centers for Medicare and Medicaid Services; 2003.
11. Love MB, Gardner K, Legion V. Community health workers: who they are and what they do. Health Educ Behav 1997;24:510–22.
12. Norris SL, Chowdhury FM, Le KV, et al. Effectiveness of community health workers in the care of persons with diabetes. Diabet Med 2006;23:544–56.
13. Rosenthal EL, Wiggins N, Brownstein JN, et al. Report of the National Community Health Advisor Study: weaving the future. Tucson: University of Arizona Health Sciences Center, 1998.
14. Satterfield DW, Burd C, Valdez L, Hosey G, Eagle Shield J. The "in-between" people: participation of community health representatives in diabetes prevention and care in American Indian and Alaskan Native communities. Health Promot Pract 2002;3:166–75.
15. Brownstein JN, Cheal N, Ackermann SP, Bassford TL, Campos-Outcalt D. Breast and cervical cancer screening in minority populations: a model for using lay health educators. J Cancer Educ 1992;7:321–6.
16. Brownstein JN, Rosenthal EL. The challenge of evaluating CHA services. In: Report of the National Community Health Advisor Study: weaving the future. Tucson: University of Arizona Health Sciences Center, 1998:50–74.
17. American Medical Association. AMA's response to Institute of Medicine recommendation, 2003. Available at: www.ama-assn.org/ama/pub/category/10243.html.
18. The Cochrane Collaboration. Cochrane reviewers' handbook (updated March, 2004). Chichester, UK: John Wiley & Sons, Ltd., 2005.
19. Becker DM, Yanek LR, Johnson WR Jr, et al. Impact of a community-based multiple risk factor intervention on cardiovascular risk in black families with a history of premature coronary disease. Circulation 2005;15;111:1298–304.
20. Bloom JR, Syme SL, Pendergrass S, Robinson RG. Improving hypertension control through tailoring: a pilot study using selective assignment of patients to treatment approaches. Patient Educ Couns 1987;10:39–51.
21. Bone LR, Mamon J. Emergency department detection and follow-up of high blood pressure: use and effectiveness of CHWs. Am J Emerg Med 1989;7:16–20.
22. Fedder DO, Chang RJ, Curry S, Nichols G. The effectiveness of a community health worker outreach program on healthcare utilization of west Baltimore City Medicaid patients with diabetes, with or without hypertension. Ethn Dis 2003;13:22–7.
23. Felix-Aaron K, Bone LR. Using participant information to develop a tool for the evaluation of CHW outreach services. Ethn Dis 2002;12:87.
24. Frate DA, Johnson SA, Sharpe TR. Solutions to the problems of chronic disease management in rural settings. J Rural Health 1985;1:52–9.
25. Hill MN, Han HR, Dennison CR, et al. Hypertension care and control in underserved urban African American men: behavioral and physiologic outcomes at 36 months. Am J Hypertens 2003;16:906–13.
26. Hill MN, Bone LR, Hilton SC, Roary MC, Kelen GD, Levine DM. A clinical trial to improve high blood pressure care in young urban black men: recruitment, follow-up, and outcomes. Am J Hypertens 1999;12:548–54.
27. Hovell MF, Geary DC, Black DR, Kamachi K, Kirk R. The effects of lay counseling on medication adherence and blood pressure: adjunctive treatment for hypertension. Patient Educ Couns 1984;6:91–4.
28. Krieger J, Collier C, Song L, Martin D. Linking community-based blood pressure measurement to clinical care: a randomized controlled trial of outreach and tracking by community health workers. Am J Public Health 1999;89:856–61.
29. Levine DM, Bone L. The impact of a planned health education approach on the control of hypertension in a high risk population. J Hum Hypertens 1990;4:317–21.
30. Levine DM, Bone LR, Hill MN, et al. The effectiveness of a community/academic health center partnership in decreasing the level of blood pressure in an urban African-American population. Ethn Dis 2003;13:354–61.
31. Morisky DE, DeMuth NM, Field-Fass M, Green LW, Levine DM. Evaluation of family health education to build social support for long-term control of high blood pressure. Health Educ Q 1985;12:35–50.
32. Morisky DE, Lees NB, Sharif BA, Liu KY, Ward HJ. Reducing disparities in hypertension control: a community-based hypertension control project (CHIP) for an ethnically diverse population. Health Promot Pract 2002;3:264–75.
33. Frate DA, Whitehead T, Johnson SA. Selection, training, and utilization of health counselors in the management of high blood pressure. Urban Health 1983;12:52–4.
34. Levine DM, Green LW, Deeds SG, Chwalow J, Russell RP, Finlay J. Health education for hypertensive patients. JAMA 1979;241:1700–3.
35. Levine DM, Green LW, Morisky D. Effect of a structured health education program on reducing morbidity and mortality from high blood pressure. Bibllthca Cardiol 1987;42:8–16.
36. Levine DM, Becker DM, Bone LR, et al. A partnership with minority populations: a community model of effectiveness research. Ethn Dis 1992;2:296–305.
37. Levine DM, Becker DM, Bone LR. Narrowing the gap in health-status of minority populations—a community academic medical-center partnership. Am J Prev Med 1992;8:319–23.

38. Morisky D, Levine D, Green L, et al. Five-year blood pressure control and mortality following health education for hypertensive patients. Am J Public Health 1983;73:153–62.
39. Garcia-Penne C, Thorogood M, Armstrong B, Reyes-Frausto S, Munoz L. Pragmatic randomized trial of home visits by a nurse to elderly people with hypertension in Mexico. Int J Epidemiol 2001;30:1458–91.
40. Hill MN, Becker DM. Roles of nurses and health workers in cardiovascular health promotion. Am J Med Sci 1995;310(suppl 1):S123–6.
41. New J, Mason J, Freemande N, et al. Specialist nurse-led intervention to treat and control hypertension and hyperlipidemia in diabetes (SPLINT). Diabetic Care 2003;26:2250–5.
42. Ward HJ, Morisky NB, Lees NB, Fong R. A clinic and community-based approach to hypertension control for an underserved minority population: design and methods. Am J Hypertens 2000;13:177–83.
43. Allen JK, Scott LB. Alternative models in the delivery of primary and secondary prevention programs. J Cardiovasc Nurs 2003;18:150–6.
44. Institute of Medicine. Unequal treatment: confronting racial and ethnic disparities in health care. Washington DC: Institute of Medicine; 2002.
45. Fahey T, Schroeder K, Ebrahim S. Interventions used to improve control of blood pressure in patients with hypertension. Cochrane Database Syst Rev 2005;1:CD005182.
46. Israel BA. Social networks and social support: implications for natural helper and community level interventions. Health Educ Q 1985;12:65–80.
47. Ware JE, Kosinski M, Keller SD. SF-36 Physical and Mental Health Summary Scales: a user's manual. Boston: Health Institute, New England Medical Center, 1994.
48. Walker DG, Jan S. How do we determine whether community health workers are cost-effective? Some core methodological issues. J Community Health 2005;30:221–9.
49. Zuvekas A, Nolan L. Impact of community health workers on access, use of services, and patient knowledge and behavior. J Ambul Care Manage 1999;22:33–44.
50. Council on Linkages Between Academia and Public Health Practice. Competencies project, 2005. Available at: www.trainingfinder.org/competencies/list.htm.
51. Pickering TG, Hall JE, Appel LJ, et al. Recommendations for blood pressure measurement in humans: an AHA scientific statement from the Council on High Blood Pressure Research Professional and Public Education Subcommittee. J Clin Hypertens (Greenwich) 2005;7:102–9.
52. National Heart, Lung, and Blood Institute. Your Heart Your Life: a lay health educator's program. National Institutes of Health, 2006. Available at: http://hp2010.nhlbihin.net/salud/pa/index.htm.
53. National Heart, Lung, and Blood Institute. Honoring the gift of heart health: a heart health educator's manual. Washington DC: U.S. Department of Health and Human Services, Indian Health Service, 2006.
54. Centers for Disease Control and Prevention. The community health worker's heart disease and stroke sourcebook. Atlanta GA: Centers for Disease Control and Prevention, 2007.
55. Humbert N. Chronic disease and disability in times of disaster. Presented at the Centers of Disease Control and Prevention's 2006 National Health Promotion Conference, September 12, 2006, Atlanta, Ga.
56. California Academic Chronic Care Collaborative. Improving chronic illness care. The chronic care model, 2005. Available at: www.improvingchroniccare.org/change/index.html.
57. Ro MJ, Treadwell HM, Northridge M. Community health workers and community voices: promoting good health. Atlanta GA: Morehouse School of Medicine, 2003.