The Potency of Team-Based Care Interventions for Hypertension
A Meta-analysis

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Background: Team-based care is the strategy that has had the greatest effect on improving blood pressure (BP). The purpose of this systematic review was to determine the potency of interventions for BP involving nurses or pharmacists.

Methods: A MEDLINE search for controlled clinical trials that involved a nurse or pharmacist intervention was conducted. Mean reductions in systolic (S) and diastolic (D) BP were determined by 2 reviewers who independently abstracted data and classified the different intervention components.

Results: Thirty-seven articles met the inclusion criteria. Education about BP medications was significantly associated with a reduction in mean BP (−8.75/−3.60 mm Hg). Other strategies that had large effect sizes on SBP include pharmacist treatment recommendations (−9.30 mm Hg), intervention by nurses (−4.80 mm Hg), and use of a treatment algorithm (−4.00 mm Hg). The odds ratios (95% confidence intervals) for controlled BP were: nurses, 1.69 (1.48-1.93); pharmacists within primary care clinics, 2.17 (1.75-2.68); and community pharmacists, 2.89 (1.83-4.55). Mean (SD) reductions in SBP were: nursing studies, 5.84 (8.05) mm Hg; pharmacists in clinics, 7.76 (7.81) mm Hg; and community pharmacists, 9.31 (5.00) mm Hg. There were no significant differences between the nursing and pharmacy studies (P ≥ .19).

Conclusions: Team-based care was associated with improved BP control, and individual components of the intervention appeared to predict potency. Implementation of new hypertension guidelines should consider changes in health care organizational structure to include important components of team-based care.

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Blood pressure (BP) is poorly controlled in the United States. The 8th Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (JNC-8) is currently considering strategies to improve the implementation of the guidelines and achieve higher BP control rates. Investigators from the Stanford University/University of California, San Francisco, Evidence-Based Practice Center conducted an analysis of controlled clinical trials examining quality improvement strategies and found that the only strategy that significantly improved BP was team-based care. Most of the quality improvement interventions included multiple components. These different strategies or the potency of the intervention may explain the apparent differences in effect sizes.

One strategy to improve guideline adherence is to use team-based care involving pharmacists or nurses. The purpose of the present study was to conduct a systematic review of the research literature and to evaluate the potency of team-based care involving pharmacists or nurses. We theorized that the effect size would be greater for nurses or pharmacists working in a physician’s office or more independently by protocol than with more distant interventions, such as recommendations from a community pharmacist.
port outcomes from at least 3 time points in the preintervention and postintervention periods.6

SEARCH STRATEGY

Walsh et al6 performed their search of the MEDLINE database from January 1, 1980, through July 31, 2003, and we extended the search to include articles published from January 1, 1970, through February 5, 2009. The search was conducted by a research librarian. Titles and abstracts were then screened to determine whether the article included team-based care of hypertension involving pharmacists or nurses. Next, we searched the reference list of included papers and the reviews by Walsh et al6 to identify additional citations. Once the full-text articles were selected, 2 reviewers (1 clinical pharmacist with a PharmD [doctor of pharmacy] degree [M.R.] and 1 nurse with a PhD [doctor of philosophy] degree [J.D.]) independently determined whether each paper met the study criteria. If so, the reviewers independently abstracted critical information including study design, setting, type of intervention, components of the intervention, and degree of SBP and DBP change. The intervention components included supplying free medications, education about BP medications, counseling about lifestyle modifications, assessing medication compliance, algorithms for treatment, home visits, prescribing medications by intervention health care providers (nurses or pharmacists), laboratory tests ordered by intervention health care providers (nurses or pharmacists), and pharmacy interventions delivered in community pharmacies, and interventions by clinical pharmacists working within a primary care office. We performed sensitivity analyses to determine the effect of assigning studies to different categories when they had multiple strategies (eg, involved both community pharmacists and nurses).

STATISTICAL ANALYSIS

Stepwise regression analyses and non-parametric analyses were performed using the Mann-Whitney test to evaluate the postintervention difference between the intervention and control groups for mean SBP and DBP while controlling for study sample size. Analyses were performed using SPSS statistical software, version 17.0.0 (SPSS Inc, Chicago, Illinois).

One study had a large number of informed dropouts and found no significant difference between nurse vs physician management. A stepwise regression analysis was conducted without this study (n=36) to predict the effect of individual intervention components on BP. Unadjusted ORs for controlled BP were calculated so studies could be compared. The ORs were compared using a simple logistics regression model with 1 variable, unadjusted for any other item. We created a funnel plot of the log of the OR plotted against the standard error for each study to assess the possibility that publication bias might exist.

RESULTS

Figure 1. Flow diagram depicting reasons trials were excluded.

The literature review identified 583 citations and 37 articles that met the inclusion criteria (Figure 1). Inter-rater reliability for the 2 reviewers was good (Pearson product moment correlation r=0.74; P<.001).

Each study specified unique health care provider qualifications and training. For instance, studies involving community pharmacists may have included pharmacists with BS (bachelor of science) degrees,22,25 or those with PharmD degrees.20,22 Nearly all studies that involved pharmacists in clinics included clinical pharmacists with PharmD or MS (master of science) degrees who had completed postdoctoral residency training in primary care and whose duties involved direct patient management,24,26,28,30,34,36,48 although several studies did not provide these details.25,27,35,46 Most of the studies involving nurses did not specify their qualifications,17,19,33,38,41,44,45,47 but some noted that health care providers were registered nurses (RNs)42,49 or nurse practitioners.16,18 Training of the intervention nurses or pharmacists typi-
This study found that interventions involving pharmacists or nurses were associated with significantly improved BP control. These results ex-
tended those of the previous report\textsuperscript{6} that found involving pharmacists or nurses was the most potent quality improvement strategy to improve BP control. We also wanted to determine whether specific aspects of team care were more potent. Our analysis found that studies involving pharmacists resulted in not only lower BP but also a greater OR of achieving BP control compared with studies involving nurses. However, the reductions in SBP and CIs for controlled BP overlap for the different health care providers (Figure 2).

We had hypothesized that studies involving community pharmacists would be less potent than those involving nurses or pharmacists within primary care clinics. Of interest, studies involving community pharmacists had the highest OR (2.89). These findings may be based on how the reviewers categorized the studies. First, one study conducted in community pharmacies in Portugal had an extremely high OR (29.71).\textsuperscript{22} Another study in a community pharmacy had an OR of 4.29, but this pharmacist worked closely with 2 physicians and reviewed medical records of study participants in the physicians’ office.\textsuperscript{20} We could also have classified this study as “pharmacist in the clinic,” which would have reduced the OR for community pharmacy studies and increased the OR for studies involving pharmacists in clinics. Second, we classified one study as a nursing intervention for the OR calculations, but the intervention involved both a nurse and a community pharmacist (OR, 1.79).\textsuperscript{19} Excluding the first 2 studies and adding the third study to the analysis of community pharmacy studies would have resulted in an OR closer to 1.8 for the community pharmacy group.

Finally, one large study was conducted within a managed care organization that involved education by a pharmacist via the Internet.\textsuperscript{35} We had no prior established relationship with the physicians and the interventions were only 4 and 5 months in length. These studies had modest ORs for controlled BP (1.56, 1.74, and 2.46). Carter et al\textsuperscript{52} recently completed a randomized, controlled effectiveness (ie, pragmatic) study of a 6-month pharmacist intervention among 402 patients from 6 family medicine clinics that was not included in this systematic review because it had not been published at the time of our evaluation. In that study, SBP was reduced by 12.0 mm Hg more in the intervention group than the control group, and the OR for controlled BP was 3.2 (95% CI, 2.0-5.1). Finally, these investigators conducted an efficacy study in which BP was controlled in 54% of patients in the control group and 89% in the intervention group (OR, 7.38; 95% CI, 3.43-15.91)\textsuperscript{30} The main reason for high BP control in this latter study was attributed to assertive and frequent medication

### Table 2. Effect of Quality Improvement Strategies on BP Outcomes

<table>
<thead>
<tr>
<th>Type of Quality Improvement</th>
<th>Median Reduction in Systolic BP (IQR), mm Hg</th>
<th>Median Reduction in Diastolic BP (IQR), mm Hg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free medications</td>
<td>18, 39, 50</td>
<td>18, 39, 50</td>
</tr>
<tr>
<td>Pharmacist recommended</td>
<td>8, 20-24, 26, 27, 29, 30, 35, 37, 43, 46, 48</td>
<td>8, 20-24, 26, 27, 29, 30, 35, 37, 43, 46, 48</td>
</tr>
<tr>
<td>Education about BP</td>
<td>8, 17-23, 26-30, 32, 34, 35, 37, 39-44, 46-50</td>
<td>8, 17-23, 26-30, 32, 34, 35, 37, 39-44, 46-50</td>
</tr>
<tr>
<td>Pharmacist performed</td>
<td>8, 19-22, 24-30, 34-37, 41, 43, 46, 48, 50</td>
<td>8, 19-22, 24-30, 34-37, 41, 43, 46, 48, 50</td>
</tr>
<tr>
<td>Drug profile and/or</td>
<td>8, 17, 20, 21, 23, 25-29, 27, 29, 30, 32</td>
<td>8, 17, 20, 21, 23, 25-29, 27, 29, 30, 32</td>
</tr>
<tr>
<td>History completed</td>
<td>35, 40, 42-44, 46, 48</td>
<td>35, 40, 42-44, 46, 48</td>
</tr>
<tr>
<td>Counseling about lifestyle</td>
<td>8, 16, 17, 19-23, 26-32, 34, 35, 37, 38, 40-42, 45-50</td>
<td>8, 16, 17, 19-23, 26-32, 34, 35, 37, 38, 40-42, 45-50</td>
</tr>
<tr>
<td>Intervention provider could</td>
<td>16, 22, 25, 31, 33, 44, 48-50</td>
<td>16, 22, 25, 31, 33, 44, 48-50</td>
</tr>
<tr>
<td>order laboratory tests</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nurse performed intervention</td>
<td>16-19, 31-33, 38-42, 44, 45, 47, 49</td>
<td>16-19, 31-33, 38-42, 44, 45, 47, 49</td>
</tr>
<tr>
<td>Treatment algorithm used</td>
<td>16, 23, 25, 32, 33, 35, 37, 44, 49</td>
<td>16, 23, 25, 32, 33, 35, 37, 44, 49</td>
</tr>
<tr>
<td>Made a home visit</td>
<td>17, 18, 38, 41, 44</td>
<td>17, 18, 38, 41, 44</td>
</tr>
<tr>
<td>Intervention provider could</td>
<td>16, 25, 28, 32</td>
<td>16, 25, 28, 32</td>
</tr>
<tr>
<td>prescribe medication</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical examination</td>
<td>16, 25</td>
<td>16, 25</td>
</tr>
</tbody>
</table>

Abbreviations: BP, blood pressure; IQR, interquartile range.
\textsuperscript{a}When the sample size is 2 studies, the numbers in parentheses show the actual results of each study rather than the interpolated interquartile range.
\textsuperscript{b}P < .10 for Mann-Whitney analysis of reduction in systolic and diastolic BP comparing studies with the quality improvement strategy with those without.
\textsuperscript{c}P < .05 for Mann-Whitney analysis of reduction in systolic and diastolic BP comparing studies with the quality improvement strategy with those without.

\(\text{Figure 2.}\)
intensification recommended by the pharmacist. Therefore, the ORs for the 5 studies by these investigators were: community pharmacy studies (BS-trained pharmacists), between 1.56 and 2.46; the pragmatic trial of clinical pharmacists (PharmD with residency or fellowship), 3.20; and the efficacy trial (ideal intervention delivery) with clinical pharmacists (PharmD with residency), 7.38.

Therefore, when the literature involving team care is evaluated, it is critical to assess the duration of the intervention, the type of organization in which the intervention is performed (home, work site, community pharmacy, or primary care clinic), and whether the study is an efficacy or effectiveness trial. These factors, as well as the intervention procedures, predict the potency of the intervention.

Studies involving community pharmacists largely involved making recommendations to physicians by telephone or facsimile. Studies involving pharmacists in clinics typically involved pharmacists employed in the clinic who worked collaboratively with physician colleagues and/or provided more autonomous care. Pharmacists within primary care clinics work closely with physicians, and the expected levels of trust and cooperation might be higher than with community pharmacists, for whom interaction is usually not in person and occurs from distant locations. In fact, recommendations to change BP medications were accepted 95% of the time from pharmacists within the same clinic but only 45% to 50% when recommen-

Figure 2. The odds ratio (OR) (confidence interval [CI]) that systolic blood pressure is controlled in the intervention group compared with the control group. A higher OR indicates a more effective intervention. A, Eight studies involving nurses. B, Five studies conducted in community pharmacies. C, Nine studies involving pharmacists in primary care clinics.

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edicated education in medication pharmacists receive 4 years of con-
tinued counseling techniques that phar-
macy practitioners usually do not. Likewise,

interventions seemed more likely to in-
volve home visits, use of a treatment
algorithm, and patient engagement
than pharmacy studies. It is likely that many of the interventions
involving nurses or pharmacists in-
creased patient empowerment, but
few studies specifically provided such
descriptions. Only 5 nursing studies
described a patient-led process,6,17,19,49

Each intervention or combina-
tion of intervention components is
unique. It is not possible to state that
either nurses or pharmacists can im-
prove BP control without first deter-
mining the patient population, the
organizational structure involved, and
the amount of autonomy the inter-
ventionist has to alter therapy. Strate-
gies that provided medication edu-
cation were the most effective, but this
strategy is impossible to evaluate alone
because it was usually provided with
additional strategies by the nurse or
pharmacist who may have recom-
mended therapy changes or person-
ally changed therapy within a pri-
cary care office. Any incremental
addition of components from Table 2
that a physician office or health sys-
tem can implement should improve
BP control rates, but this requires ad-
ditional research. We believe that
nurses possess unique skills in pa-
tient management and nonmedica-
tion counseling techniques that phar-
macists usually do not. Likewise,
pharmacists receive 4 years of con-
centrated education in medication
pharmacology, pharmacokinetics,
pharmacodynamics, therapeutics, and
chronic disease drug-therapy guide-
lines. Including both nurses and phar-
macists in an integrated hyperten-
sion management program should be
even more effective, and more cost-
effective, than including either group
alone. Consistent with our findings,
the pharmacists could adjust medi-
cation management program should be
implemented by physicians.51,53

Figure 3. Funnel plot for all studies included in Figure 2. OR indicates odds ratio.

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was $48 per millimeter of mercury in the pharmacist-managed clinic and $151 in the physician clinic.

Twelve studies (9 nursing, 2 in community pharmacies, and 1 pharmacist in clinics) were conducted in countries other than the United States. It is not known what effects the unique characteristics of the health care system in these countries might have had on the interventions. Likewise, some studies were conducted in integrated managed care settings or the Department of Defense or Veterans Administration. Future research should clarify the functional components of a team and how best to utilize the strengths of team members as they fit into the chronic care model. Also, the larger impact of the health care delivery system on the potency of these interventions should be assessed, specifically whether incentives might be aligned to optimize performance. Finally, we cannot rule out publication bias in our analyses because only 3 studies had high ORs and low standard error.

CONCLUSION

This evaluation of team-based care for hypertension found that interventions involving nurses or pharmacists are effective strategies to improve BP control. Several individual components were associated with improvements in BP. Research involving team-based care must be carefully designed, reported, and interpreted to include the organizational structure in which the intervention is performed, the educational level and training of the intervention providers, and the individual components of the intervention so that similar interventions can be implemented within a given health system.

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Author Contributions: All authors had full access to all the data and take responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Carter and James. Acquisition of data: Carter, Rogers, and Daly. Analysis and interpretation of data: Carter, Rogers, and Zheng. Drafting of the manuscript: Carter. Critical revision of the manuscript for important intellectual content: Carter, Rogers, Daly, Zheng, and James. Statistical analysis: Zheng. Obtained funding: Carter. Administrative, technical, and material support: Rogers, Daly, Zheng, and James. Study supervision: Carter.

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