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Online First Blood Pressure 1 Year After Completion of Web-Based Pharmacist Care

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Meta-analyses provide strong evidence that blood pressure (BP) control improves with "team-based" hypertension care provided by a health professional such as a pharmacist or nurse, separate from physician care.[1] Few studies have analyzed whether team care leads to sustained BP reductions after the end of an intervention.

In the Electronic Communications and Home Blood Pressure Trial (e-BP),[2] patients with uncontrolled BP were registered to use an existing patient website (with a patient-shared electronic health record [EHR] and secure e-mail) and randomly assigned to receive the following interventions: (1) usual care (UC), (2) home BP monitoring (BPM) and website training, or (3) BPM and website training plus pharmacist team-care delivered via the website (Pharm). At the end of the 1-year intervention, Pharm patients were twice as likely to have controlled BP.[2] Our objective was to determine if BP reductions were sustained after the intervention ended.

Methods

Details of the study design[3] and main study results[2] have been previously published. The Group Health institutional review board approved all study procedures.

We collected all BPs available in the EHR from participants' primary care visits between 18 and 30 months after randomization (approximately 6 to 18 months after completion of all interventions). If more than 1 BP was available, the BP closest to 24 months (defined as 1-

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Author Contributions: Ms Anderson and Dr Cook had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. *Study concept and design:* Green, Ralston, Catz, and Cook. *Acquisition of data:* Green. *Analysis and interpretation of data:* Green, Anderson, Ralston, Catz, and Cook. *Drafting of the manuscript:* Green and Anderson. *Critical revision of the manuscript for important intellectual content:* Green, Anderson, Ralston, Catz, and Cook. *Statistical analysis:* Green, Anderson, and Cook. *Obtained funding:* Ralston. *Administrative, technical, and material support:* Green. *Study supervision:* Green.
Additional Contributions: Robert S. Thompson, MD (emeritus director, Group Health Department of Preventive Medicine) contributed to the study design; Paul Fishman, PhD (senior investigator, health services and economics) contributed to the study design and analysis; and Jim Carlson, PharmD, Danette Feuling, RPh, Shannon Clarke, PharmD, and Jilene Winther, PharmD, assisted in the study as clinical pharmacists.
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Online-Only Material: The eTable is available at http://www.jamainternalmed.com.

year after intervention) was used. Primary outcomes included change in baseline systolic BP (SBP) and diastolic BP (DBP) and BP control at 1 year after intervention. Secondary outcomes, including number (by class)[2] and adherence to[4] antihypertensive medications and utilization of health care services, were calculated using automated data. Preplanned subanalyses included assessments of the patients with a baseline SBP of 160 mm Hg or higher.

Analysis was limited to trial participants with a BP measurement in the EHR from a primary care visit in the defined period (N=618, after 160 were excluded). Linear regression models were used to evaluate changes in BP from baseline. A modified Poisson regression approach, using generalized linear models with a log-link linear and a robust sandwich variance estimator, was used to estimate the relative risk (RR) of BP control[5] (SBP <140 mm Hg and DBP <90 mm Hg). Regression models were adjusted for baseline BP, sex, prestudy home BP monitoring use, clinic, and time between the end of the intervention and the EHR BP measurement. To protect against multiple comparisons, the Fisher protected least significant difference approach was used; pairwise comparisons were made between intervention groups only if the overall omnibus test result was significant.[6] Analyses of secondary outcomes were unadjusted. All analyses used Stata statistical software, version 12.0 (StataCorp).

Results

Of the 778 patients enrolled in the trial, 725 (93%) remained enrolled in Group Health (49 had disenrolled and 4 had died) and 618 (79%) had a BP measurement recorded in the EHR 1-year after intervention. Characteristics of the 618 patients with BPs were comparable across randomization groups and were similar to those excluded, except for less prestudy home BP monitoring prior to the study in those excluded.

At 1-year after intervention, all 3 groups had lower SBP and DBP compared with baseline (Table), with the Pharm group having significantly larger decreases in SBP than UC and BPM (difference in adjusted mean change, −3.6 mm Hg [*P*=.02], and −6.8 mm Hg [*P* < .001], respectively). Change in DBP did not differ between groups. The Pharm group had higher rates of BP control compared with the UC group (*P*=.11) and had significantly higher rates of BP control compared with the BPM group (*P*=.01) (UC, 52%; BPM, 48%; and Pharm, 60%).

In patients with a BP of 160mmHg or higher at baseline, BP control was 34%, 23%, and 56% in the UC, BPM, and Pharm groups (adjusted relative risk of controlled BP [Pharm vs UC], 1.87 [95% CI, 1.06 to 3.17]), with an adjusted difference in mean change in SBP of −10.5 (95% CI, −18.3 to −2.7 mm Hg) (Pharm vs UC).

The mean number of antihypertensive classes was significantly higher in the Pharm and BPM groups compared with the UC group. Adherence was high for all groups but significantly higher in the Pharm and BPM groups than in the UC group (eTable). Primary care and hospital utilization did not differ by group (eTable).

Discussion

Web-delivered pharmacy team care resulted in greater reductions in SBP and improved BP control 6 to 18 months after the completion of interventions. Similar to Wentzlaff et al[7] and Carter et al,[8] the control group (UC) continued to improve, and differences between groups narrowed. In our study team care, BP benefits occurred mainly in those with more severe hypertension at baseline, with Web-based pharmacist team patients almost twice as likely to

have controlled BP. Limitations included reliance on a single EHR BP measurement[9] and no EHR BP measurement recorded in 21% of study participants. However, significant differences in BP persisted in sensitivity analyses that assumed that BP remained unchanged from baseline for those without EHR BP measurements. More studies are needed to assess BP and clinical outcomes at longer intervals and whether team-care booster interventions improve these outcomes.

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Table

Blood Pressure (BP) Outcomes 1 Year After Interventions[a]

Variable	UC	BPM	Pharm	*P* Values for Differences Between Groups			
				Overall[b]	UC vs BPM[c]	UC vs Pharm[c]	BPM vs Pharm[c]
All e-BP participants (N = 618), No.	202	209	207				
SBP, mean (95% CI), mm Hg							
Unadjusted mean	137.7 (135.4 to 140.0)	140.9 (138.6 to 143.1)	134.3 (132.1 to 136.6)	<.001	.05	.04	<.001
Adjusted mean change[d]	−14.1 (−16.3 to −11.9)	−10.9 (−13.1 to −8.7)	−17.7 (−19.9 to −15.5)	<.001	.04	.02	<.001
DBP, mean (95% CI), mm Hg							
Unadjusted mean	80.1 (78.7 to 81.6)	80.5 (79.1 to 81.9)	78.5 (77.1 to 80.0)	.13	.71	.12	.06
Adjusted mean change[d]	−9.2 (−10.5 to −7.9)	−8.4 (−9.7 to −7.1)	−10.2 (−11.5 to −8.9)	.17	.38	.31	.06
BP controlled							
Unadjusted, % (95% CI)	52 (46 to 59)	48 (42 to 55)	60 (54 to 67)	.04	.40	.11	.01
Adjusted RR (95% CI)[e]	1 [Reference]	0.93 (0.77 to 1.13)	1.18 (0.99 to 1.40)	.02	.47	.06	.01
e-BP participants with baseline SBP ≥160 mm Hg (n = 132), No.	44	43	45				
SBP, mean (95% CI), mm Hg							
Unadjusted mean	144.9 (139.7 to 150.0)	148.9 (143.7 to 154.1)	135.9 (130.8 to 141.0)	.002	.28	.02	<.001
Adjusted mean change[d]	−21.1 (−26.6 to −15.6)	−20.4 (−26.0 to −14.9)	−31.6 (−37.0 to −26.3)	.006	.86	.009	.005
DBP, mean (95% CI), mm Hg							
Unadjusted mean	79.9 (77.0 to 82.8)	81.1 (78.2 to 84.1)	78.9 (76.0 to 81.8)	.56	.56	.62	.28
Adjusted mean change[d]	−10.1 (−12.9 to −7.2)	−9.7 (−12.6 to −6.9)	−11.8 (−14.5 to −9.1)	.54	.86	.40	.30
BP controlled							
Unadjusted, % (95% CI)	34 (20 to 48)	23 (10 to 36)	56 (41 to 70)	.008	.27	.05	.005
Adjusted RR (95% CI)[e]	1 [Reference]	0.92 (0.45 to 1.89)	1.87 (1.13 to 3.10)	.001	.82	.02	.02

Abbreviations: BPM, home blood pressure monitoring; DBP, diastolic blood pressure; e-BP, Electronic Communications and Home Blood Pressure Trial; Pharm, pharmacist team-care; RR, relative risk; SBP, systolic blood pressure; UC, usual care.

[a] The BPs were available in the electronic health record between 6 and 18 months after the e-BP study ended.

[b] *P* value from an F test for continuous outcomes and likelihood ration χ^2 test for binary outcomes for the omnibus test for a difference between any of the 3 study groups.

[c] *P* value from a Wald *t* test for continuous outcomes and a Wald *z* test for binary outcomes comparing a difference between the 2 intervention groups.

[d] Estimated mean change in the BP outcome from baseline in a linear regression model adjusted for baseline outcome, sex, BPM, clinic (with mean baseline covariate values based on the entire randomized population), and time to follow-up BP measurement.

[e] Estimated RR comparing each intervention group with UC for the outcome of controlled BP in a modified Poisson regression model adjusted for baseline SBP, sex, BPM, clinic, and time to follow-up BP measurement.