NYU Grossman School of Medicine

NYU Langone Health

Scientific Sessions

PRIMARY RESULTS OF THE BEHAVIORAL ECONOMICS TRIAL TO ENHANCE REGULATION OF BLOOD PRESSURE (BETTER-BP)

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American Heart Association.

#AHA25

BACKGROUND/ METHODS

BACKGROUND

- Nonadherence to antihypertensive medications remains a longstanding problem
- To date, many strategies designed to improve medication adherence are resource-intensive and difficult to replicate
- Barriers to medication adherence are especially high in socioeconomically disadvantaged populations[1,2]

1. Chang TE et al. *Hypertension* 2019;74:1324-32
2. Ferdinand KC et al. *JACC* 2017;69: 437-51

BACKGROUND

- Behavioral economics leverages innate human tendencies that are not always rational, including preference for immediate gains, inclination towards maintaining the status quo, and aversion to loss
- This field represents a novel and potentially scalable approach to improve antihypertensive medication adherence

PRIMARY OBJECTIVES

1. To test the effect of a mobile health text-based lottery incentive, using behavioral economics principles, on antihypertensive medication adherence
2. To evaluate the impact of this lottery on systolic blood pressure (SBP)

DESIGN

- Phase 2, multisite, randomized clinical trial
- Conducted within safety-net clinic system in NYC
- Randomization was 2:1 (incentive lottery vs. control)

FUNDING AND ORGANIZATION

Funded by the U.S. National Institutes of Health / NHLBI

R01 HL148275

Coordinating center

NYU Grossman School of Medicine

Study sites

- Bellevue Hospital
- Gouverneur Hospital
- NYU FHC Brooklyn (Federally Qualified Health Center)

TRIAL POPULATION

Inclusion

- Age ≥18 years
- Diagnosis of hypertension
- Prescribed antihypertensive medication
- Ambulatory SBP ≥140 mmHg[1]
- Missed at least 2 doses of medication in prior week[2]
- English or Spanish-speaking

Exclusion

- Clear barrier to technology use (e.g. vision or hearing impairment)
- Projected life expectancy <12 months
- Pregnant
- Incarcerated

1. Office BP within the past year; mean duration was 52 days from screened BP value to baseline visit
2. Based on self-report survey (Voils et al. *Med Care* 2012;50:1013-9)

STUDY FLOW DIAGRAM

Trial Eligible

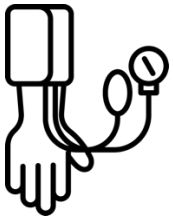
Baseline visit:
- BP measurement
- Randomized (2:1)

Intervention arm (incentive lottery)

Control Arm

6 months

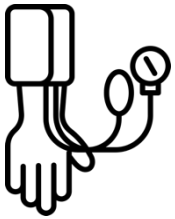
Primary clinical outcome: change in systolic BP 0 to 6 mos.



Primary process outcome: ≥80% days adherent: 0 to 6 mos.

12 months

Secondary clinical outcome: change in systolic BP 6 to 12 mos.



Secondary process outcome: ≥80% days adherent: 6 to 12 mos.

STUDY MONITORING

- Participants in both arms received an electronic monitoring device (EMD)[1]
- Cellular connectivity; registered signal when opened
- If prescribed multiple antihypertensive medications, a single agent was chosen for the device
  - Hierarchy: ACEi/ARB > calcium channel blocker > beta blocker > diuretic > other

1. EMD manufactured by Adheretech (Summit, NJ)

STUDY INTERVENTION

- Intervention arm received daily incentive lottery from baseline to 6 months, based on prior day's adherence
  - Double digit number was set for participant at start of study
  - Each day, lottery randomly generated number from 00 to 99[1]
  - If adherent, received financial reward if one number ($5) or two numbers ($50) matched
  - If nonadherent but number match, received "regret" message
  - Winnings conveyed via SMS text message, deposited monthly
- Intervention arm received passive monitoring from 6 to 12 months

1. Lottery administered by Way 2 Health (Philadelphia, PA)

STUDY INTERVENTION

Four potential conditions for incentive lottery

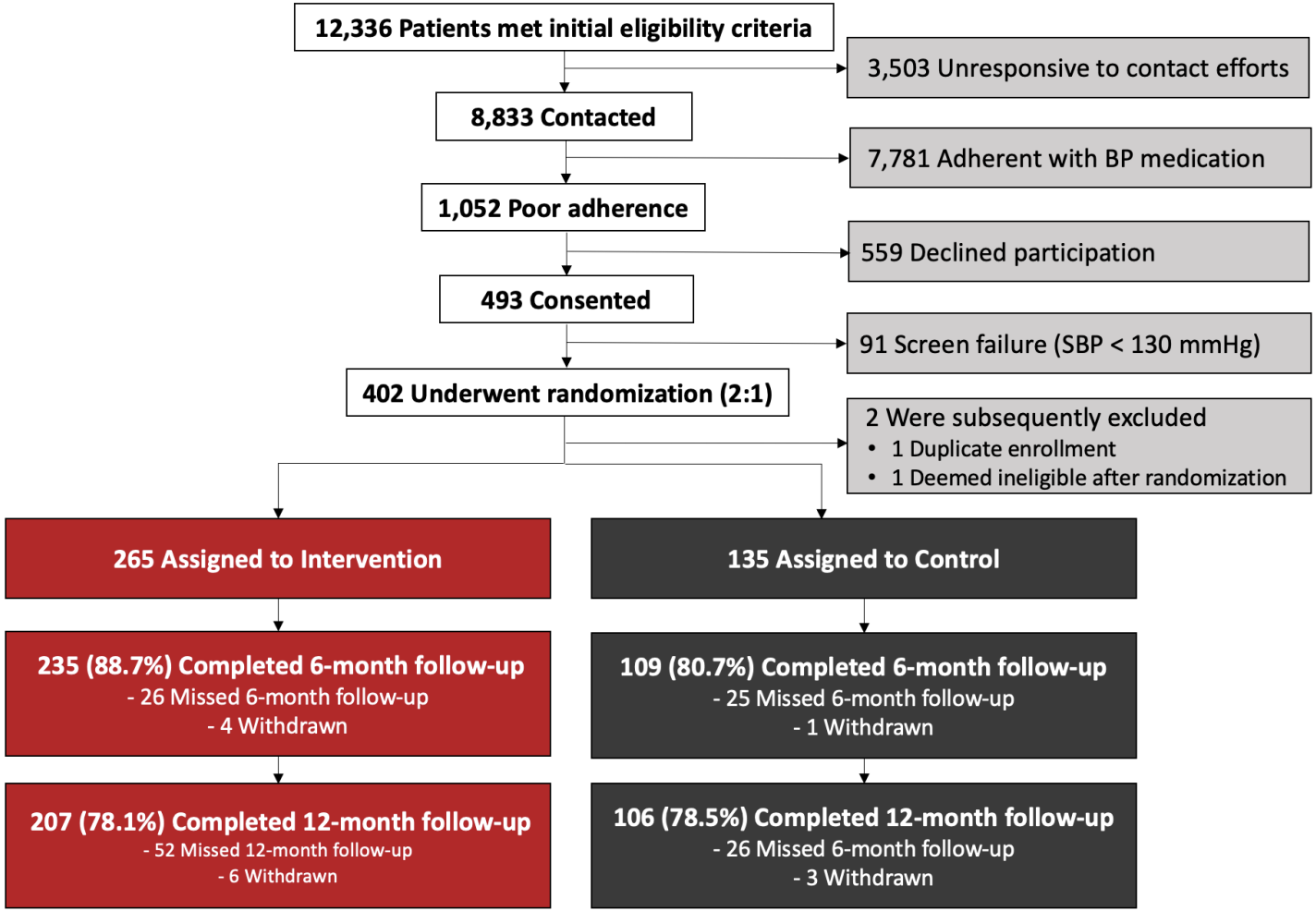
	Adherent 	Not adherent 
Wins lottery 	Lottery eligible, winning message Congratulations! You took your medication and won the lottery. The number drawn was 47 and your number is 49. You won $5. Keep up the good work!	Lottery ineligible, winning message ("regret" condition) You missed your medication yesterday. The number drawn was 47 and your number is 49. If you took your medication you would have won $5. Don't miss out!
Loses lottery 	Lottery eligible, losing message You took your medication yesterday, but your numbers weren't picked. The number drawn was 47 and your number is 21. Keep it up! Tomorrow is a new chance to win!	Lottery ineligible, losing message The number picked was 47 and your number is 21. You never know when your numbers may be chosen. Remember to take your medication every day and you may win!

POWER AND STATISTICAL ANALYSIS

- Required 401 participants (20% attrition) for 85% power to detect clinically significant change in SBP of ≥10 mmHg between intervention and control
- Primary analysis based on intention-to-treat
- Estimated mean difference for SBP, and risk ratio for adequate adherence, between treatment arms
- Performed hierarchical testing for endpoints, with 6 month SBP as the first test, using threshold of $P < 0.05$
- Multiple imputation for missing data

RESULTS

ENROLLMENT AND FOLLOW-UP



STUDY SAMPLE CHARACTERISTICS

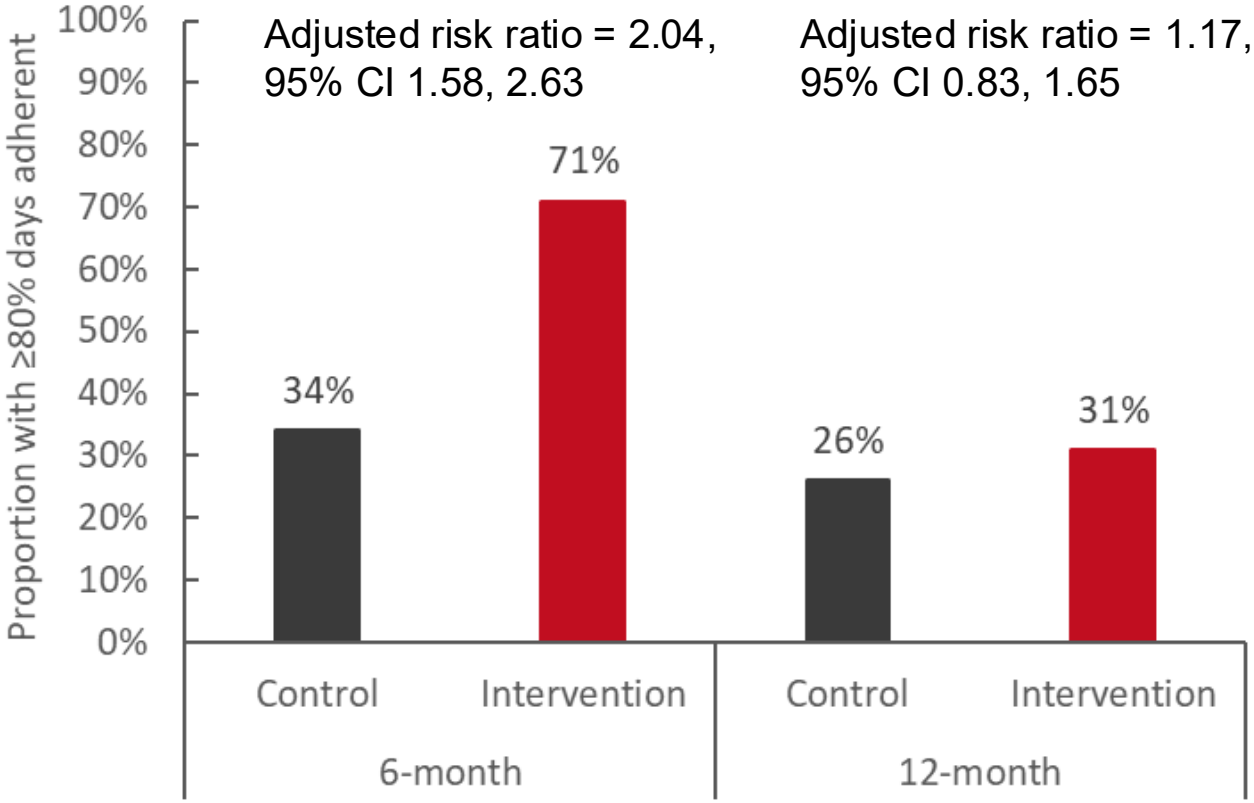
Characteristic	Intervention (N=265)	Control (N=135)
Median age, range (yr)	57 (20, 93)	56 (23, 87)
Female sex – no. (%)	157 (59.2%)	85 (63.0%)
Race and Ethnicity – no. (%)		
Hispanic	163 (61.5%)	83 (61.5%)
Non-Hispanic Asian	8 (3.0%)	3 (2.2%)
Non-Hispanic Black	61 (23.0%)	20 (14.8%)
Non-Hispanic White	7 (2.6%)	6 (4.4%)
Non-Hispanic Other or multiple	26 (9.8%)	23 (17.0%)
Insurance – no. (%)		
Commercial	38 (14.3%)	11 (8.1%)
Medicaid	102 (38.5%)	46 (34.1%)
Medicare	38 (14.3%)	22 (16.3%)
Uninsured	87 (32.8%)	56 (41.5%)
Diabetes – no. (%)	119 (44.9%)	67 (49.6%)
Obesity (BMI ≥30) – no. (%)	144 (54.3%)	74 (54.8%)
Chronic kidney disease – no. (%)	28 (10.6%)	10 (7.4%)
Tobacco use (current) – no. (%)	32 (12.1%)	11 (8.1%)

STUDY SAMPLE CHARACTERISTICS

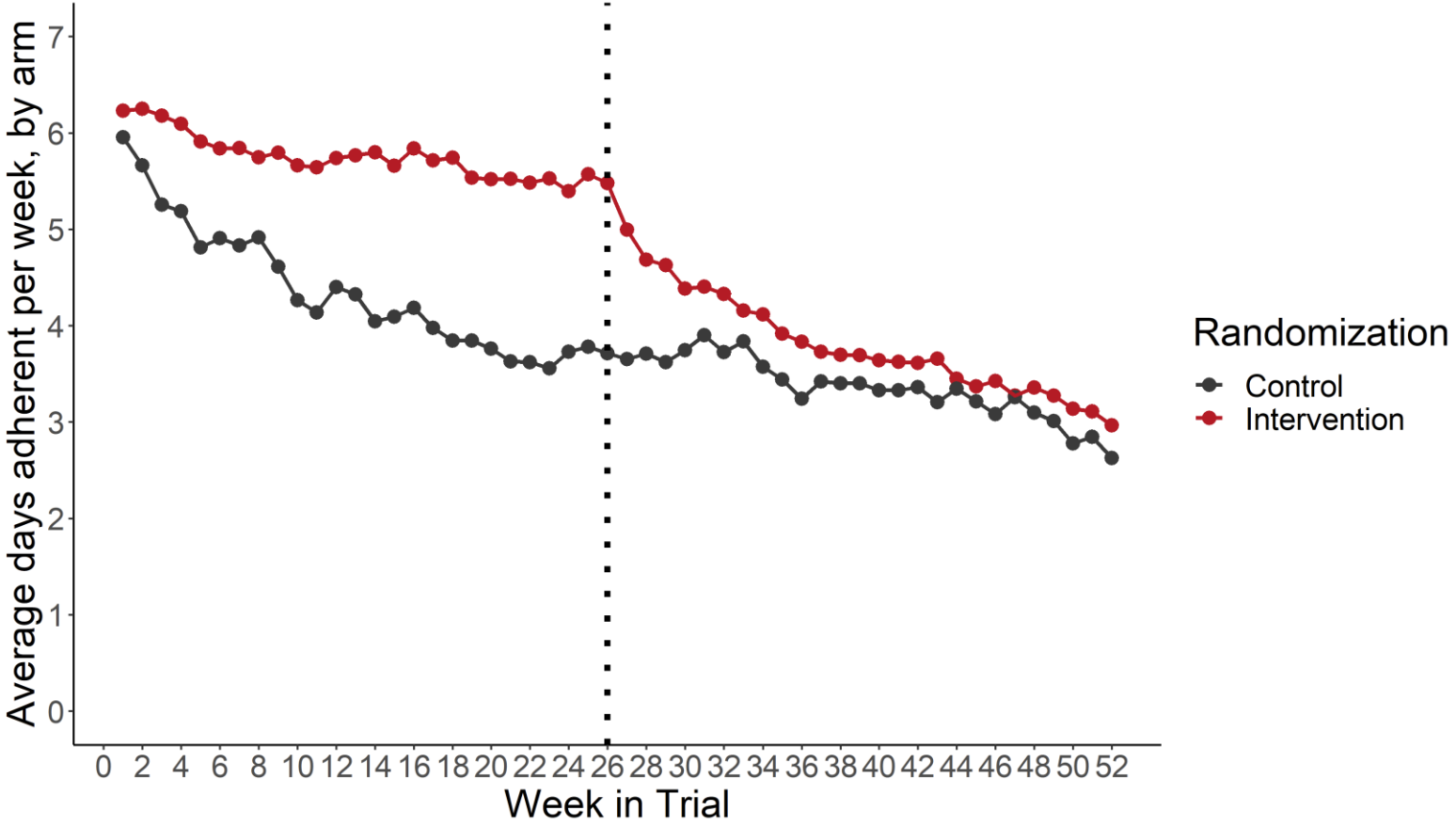
Characteristic	Intervention (N=265)	Control (N=135)
Systolic BP, mean (SD)	137.9 (19.3)	140.5 (18.6)
Diastolic BP, mean (SD)	82.1 (13.1)	82.9 (13.6)
Antihypertensive medications, mean (SD)	1.7 (0.9)	1.7 (0.8)
On >1 antihypertensive medication (%)	124 (46.8%)	64 (47.4%)
Total medications, mean (SD)	5.7 (3.3)	5.2 (3.0)
Medication chosen for monitoring		
ACE inhibitor or ARB	154 (58.1%)	76 (56.3%)
Calcium channel blocker	65 (24.5%)	40 (29.6%)
Beta blocker	10 (3.8%)	2 (1.5%)
Diuretic (thiazide or aldo antagonist)	10 (3.8%)	1 (0.7%)
Combination pill	26 (9.8%)	16 (11.9%)
Short-form 12 PCS,[1] mean (SD)	40.5 (10.2)	42.6 (10.9)
Short-form 12 MCS,[2] mean (SD)	48.3 (12.5)	47.3 (12.5)
Mean lottery payout at 6 mos., range	$212 ($10, $515)	N/A

1. PCS = physical component score
2. MCS = mental component score

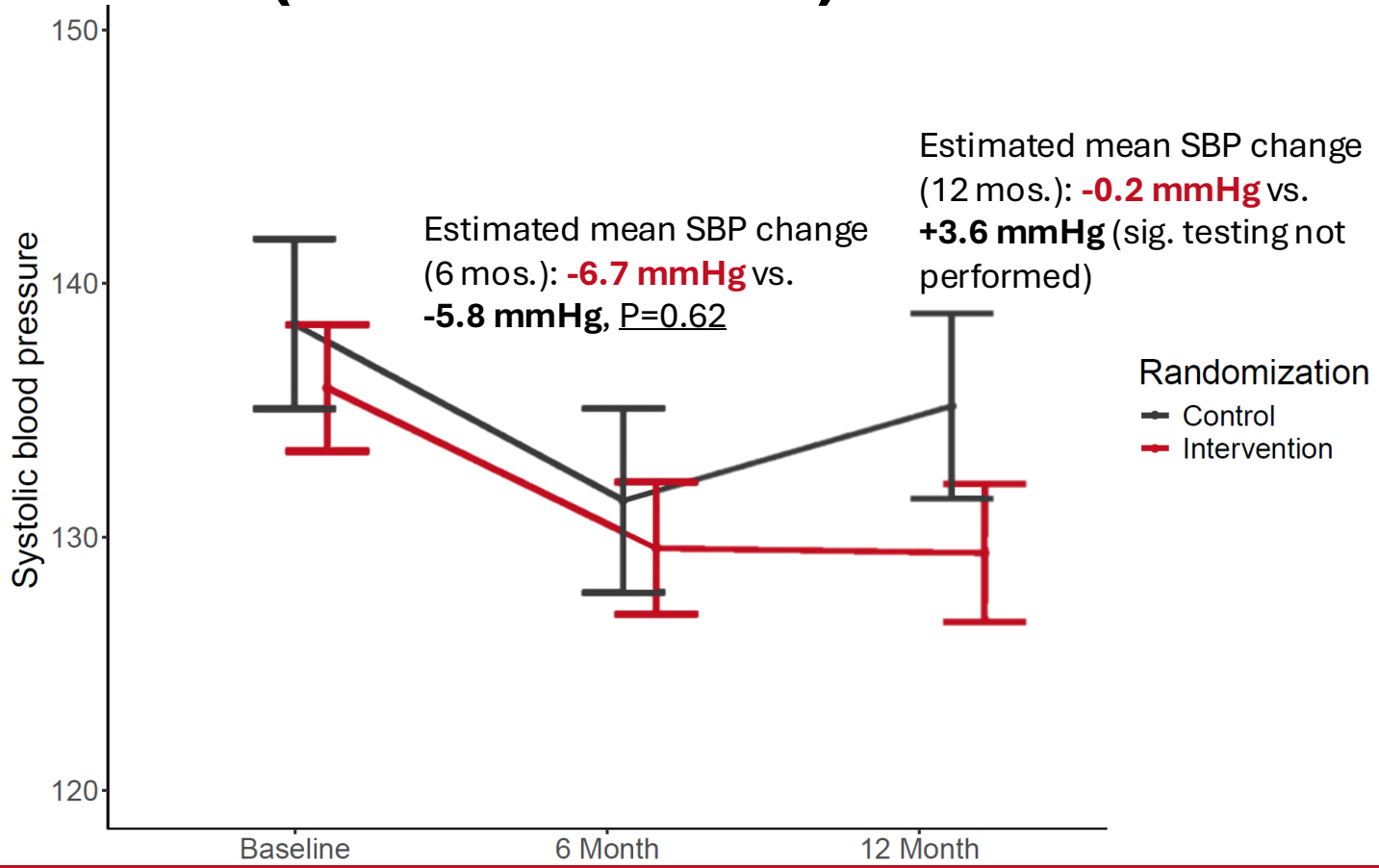
ADEQUATE ANTIHYPERTENSIVE ADHERENCE (6 & 12 MONTHS)



ANTIHYPERTENSIVE MEDICATION ADHERENCE (WEEKLY)

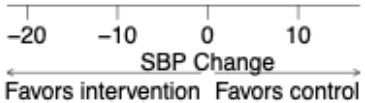


SYSTOLIC BP (6 AND 12 MONTHS)



TREATMENT EFFECT BY SUBGROUP (6 MONTH SBP)

Variable	Subgroup	b (95% CI)
Overall		−0.86 (−4.33 to 2.59)
Age	20.0–51.9 yrs	−3.78 (−9.92 to 2.36)
	52.0–60.9 yrs	2.96 (−3.83 to 9.75)
	61.0–93.0 yrs	−1.08 (−6.52 to 4.36)
Sex	Male	−0.87 (−6.68 to 4.95)
	Female	−1.09 (−5.38 to 3.19)
Race	Hispanic	1.94 (−2.23 to 6.10)
	NH Asian	4.12 (−8.55 to 16.79)
	NH Black	−7.26 (−16.54 to 2.02)
	NH White	−2.81 (−22.21 to 16.59)
	NH Other/Multiple	−8.39 (−18.65 to 1.86)
Obesity	No	0.51 (−4.79 to 5.80)
	Yes	−2.00 (−6.53 to 2.53)
Depression	No	−0.99 (−5.07 to 3.08)
	Yes	−0.74 (−7.56 to 6.09)
Charlson Index	1.0–1.9	−0.80 (−6.83 to 5.22)
	2.0–2.9	2.37 (−3.57 to 8.32)
	3.0–12.0	−1.53 (−7.36 to 4.30)
Polypharmacy	No	0.01 (−5.11 to 5.14)
	Yes	−1.35 (−6.08 to 3.39)
SF−12 PCS	11.4–36.5	0.71 (−5.32 to 6.73)
	36.6–47.1	−3.94 (−11.66 to 3.79)
	47.2–63.9	−0.88 (−5.94 to 4.18)
SF−12 MCS	10.5–41.7	0.26 (−5.28 to 5.79)
	41.8–56.5	−4.69 (−11.17 to 1.80)
	56.6–70.2	1.97 (−4.48 to 8.41)



LIMITATIONS

- Study intervention focused on single medication
- Primary outcome was in-office measurement (not home-based BP measurements)
- Usage of electronic monitoring device for adherence (rather than chemical testing)

CONCLUSIONS

- **In a safety-net population, a behavioral economics-based lottery doubled adequate antihypertensive medication adherence from baseline to 6 months.**
- This did not translate to a significant reduction in office-measured SBP versus control at 6 months.
- Increased adherence was not sustained after the lottery was removed.
- These findings suggest that other strategies will be required for long-term behavior change.

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THANK YOU

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