

**ARIC Manuscript Proposal #3847**

**PC Reviewed:** 5/11/21  
**SC Reviewed:** \_\_\_\_\_

**Status:** \_\_\_\_\_  
**Status:** \_\_\_\_\_

**Priority:** 2  
**Priority:** \_\_\_\_\_

**1.a. Full Title: Impact of the 2017 ACC/AHA Blood Pressure Guideline on Blood Pressure Control in Community-dwelling Older Adults: The ARIC Study**

**b. Abbreviated Title (Length 26 characters): 2017 BP Guideline Impact**

**2. Writing Group:**

Writing group members: Michael C. Wang, Erin D. Michos, Stephen P. Juraschek, John W. McEvoy, Lindsay Pool, Lucia Petito, Vijay Nambi, Mercedes R. Carnethon, Sadiya S. Khan

I, the first author, confirm that all the coauthors have given their approval for this manuscript proposal. MCW [please confirm with your initials electronically or in writing]

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**3. Timeline:**

- June 2021 (tentative): Data received
  - Data analysis: 4 months
  - Manuscript drafting: 2 months
- Dec 2021 (tentative): Manuscript submitted to ARIC

**4. Rationale:**

The 2017 ACC/AHA blood pressure guideline lowered both the cutoff for the diagnosis of hypertension and the blood pressure target once treatment is initiated to 130/80 mmHg.<sup>1</sup> Previous studies have estimated the potential population impact of the new guideline with perfect adherence,<sup>2,3</sup> but empirical evidence on the guidelines' actual impact is needed, particularly in light of recent evidence that national rates of hypertension control decreased between 2013 and 2018.<sup>4</sup>

The same diagnosis and treatment thresholds are recommended for older adults (age  $\geq 75$  years) as younger adults in the 2017 guideline<sup>1</sup> and, on average, older individuals may derive the greatest absolute benefit of blood pressure lowering.<sup>5</sup> However, achieving these targets in clinical practice may be challenging due to the higher risk of adverse events in this population compared with younger adults.<sup>6</sup> ARIC study exams 6 (2016-2017) and 7 (2018-2019), which predate and postdate the November 2017 blood pressure guideline, respectively, may provide some of the earliest empirical data on the impact of the guideline in community-dwelling older adults.

#### References:

<sup>1</sup>Whelton PK, Carey RM, Aronow WS, et al. 2017

ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults: Executive Summary: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *Hypertension*. 2018 Jun;71(6):1269-1324.

<sup>2</sup>Muntner P, Carey RM, Gidding S, Jones DW, Taler SJ, Wright JT Jr, Whelton PK. Potential US Population Impact of the 2017 ACC/AHA High Blood Pressure Guideline. *Circulation*. 2018 Jan 9;137(2):109-118.

<sup>3</sup>Bundy JD, Mills KT, Chen J, Li C, et al. Estimating the Association of the 2017 and 2014 Hypertension Guidelines With Cardiovascular Events and Deaths in US Adults: An Analysis of National Data. *JAMA Cardiol*. 2018 Jul 1;3(7):572-581

<sup>4</sup>Muntner P, Hardy ST, Fine LJ, et al. Trends in Blood Pressure Control Among US Adults With Hypertension, 1999-2000 to 2017-2018. *JAMA*. 2020;324(12):1190–1200.

<sup>5</sup>Williamson JD, Supiano MA, Applegate WB, et al. Intensive vs Standard Blood Pressure Control and Cardiovascular Disease Outcomes in Adults Aged  $\geq 75$  Years: A Randomized Clinical Trial. *JAMA*. 2016;315(24):2673–2682.

<sup>6</sup>Weiss J, Freeman M, Low A, et al. Benefits and Harms of Intensive Blood Pressure Treatment in Adults Aged 60 Years or Older: A Systematic Review and Meta-analysis. *Ann Intern Med*. 2017 Mar 21;166(6):419-429.

## **5. Main Hypothesis/Study Questions:**

**Hypothesis:** The 2017 ACC/AHA blood pressure guideline led to a decrease in values of measured systolic and diastolic blood pressure and an increase in self-reported antihypertensive therapy in ARIC participants (mean age ~85 years) between exams 6 and 7.

**Question 1a:** Among the ARIC participants who were reclassified by the 2017 BP guideline to Stage 1 hypertension (SBP 130-139 or DBP 80-89 mm Hg at exam 6) between exams 6 and 7, was there a difference in measured systolic and diastolic blood pressure and self-reported use of antihypertensive therapy, between exams 6 and 7 and relative to control ARIC participants who were not affected by the guideline (SBP<130 and DBP<80)?

**Question 1b:** Among the ARIC participants who were reclassified by the 2017 BP guideline to Stage 2 hypertension or greater (SBP 140+ or DBP 90+ mmHg) between exams 6 and 7 and therefore were newly recommended to be treated to <130/80 mmHg (instead of <140/90 mmHg), was there a difference in measured systolic and diastolic blood pressure and self-reported use of antihypertensive therapy, between exams 6 and 7 and relative to control ARIC participants who were not affected by the guideline (SBP<130 mmHg and DBP<80 mmHg)?

**Question 2:** Were the new hypertension cutoffs in the 2017 BP guideline (SBP 130 or DBP 80 mmHg, changed from SBP 140 or DBP 90 mmHg) associated with a difference in measured systolic and diastolic blood pressure and self-reported use of antihypertensive therapy between exams 6 and 7, for the marginal ARIC participant who was reclassified (e.g., comparing a participant just under the cutoff [SBP 129 or DBP 79 mmHg] with one just above the cutoff [SBP 130 or DBP 80 mmHg])?

**6. Design and analysis (study design, inclusion/exclusion, outcome and other variables of interest with specific reference to the time of their collection, summary of data analysis, and any anticipated methodologic limitations or challenges if present).**

**Study design:** Community-based cohort study of older adults, ARIC exam 6 (2016-2017) and exam 7 (2018-2019)

**Inclusion/exclusion:** All participants who completed exams 6 and 7 (n=3,700) and have blood pressure data for both exams, with or without antihypertensive therapy

**Outcomes:** In exam 7: Systolic and diastolic blood pressure (primary outcomes), current antihypertensive medication use (secondary outcome)

**Baseline variables:** In exam 6: Systolic and diastolic blood pressure, current antihypertensive medication use

**Covariates:** Age, sex, race/ethnicity, history of diabetes or hypertension (exams 6 and 7), history of myocardial infarction or stroke (exams 6 and 7), history of heart failure (exams 6 and 7), BMI (exam 6), Lipid panel (exam 6 if available, else exam 5), physical activity (exam 6), smoking status (exam 6)

**Data analysis:** If there is significant missing covariate data, multiple imputation will be used to impute missing data.

First, we will use a difference-in-differences approach to estimate the impact of the 2017 blood pressure guideline on ARIC participants who experienced a change either in diagnosis of or treatment threshold for hypertension between exam 6 and exam 7. We will compute the change in the outcomes of blood pressure and antihypertensive medication use, between exam 6 and exam 7, relative to the same changes among participants who were not reclassified (i.e., systolic blood pressure <130 and diastolic blood pressure <80 in exam 6) to account for secular trends independent of the guidelines. Analyses will be stratified by hypertension stage (stage 1 and stage 2 hypertension) and by hypertension treatment status for the primary outcome (measured blood pressure). We will test for differences by sex, race/ethnicity, and hypertension subtype (isolated systolic hypertension, isolated diastolic hypertension, or systolic diastolic hypertension) and report stratified estimates if significant differences are found.

Next, we will use a regression discontinuity design to estimate the impact of the 2017 blood pressure guideline on blood pressure and antihypertensive medication use, between exams 6 and 7 for the marginal ARIC participant reclassified by the newly defined cutoffs of systolic blood pressure of 130 and diastolic blood pressure of 80 mmHg. We will use systolic and diastolic blood pressure in exam 6 as running variables and fit separate cubic spline models on each side of the cutoffs for each outcome in exam 7. We will test the assumption of random assortment around the discontinuity with the McCrary method (2008). If a discontinuity is visualized for the historic hypertension cutoffs of systolic blood pressure of 140 and diastolic blood pressure of 90, we will use those cutoffs in a secondary analysis. Using the estimated marginal effect on blood pressure, we will calculate the associated prevention of cardiovascular disease and mortality and years of potential life gained for the marginal participant just above the cutoff if the BP reduction were to be sustained, and compare this to published estimates of cardiovascular disease prevention with perfect adherence to the guidelines.

In sensitivity analyses, we will: (1) exclude participants who attended Exam 6 in November or December of 2017 because of possible bias related to the release of the 2017 BP guideline in November 2017, and (2) participants who develop CVD between Exams 6 and 7.

**Anticipated limitations and challenges:** Given that exam 7 was completed within 2 years of publication of the 2017 guidelines, uptake may not be sufficient to detect a discontinuity at the new cutoffs; however, low uptake would still be an important result to report in order to motivate increased attention on guideline-directed management of hypertension.

Given that diet information was not collected after exam 4 in 1995-1999, and weight was measured in exam 6 but not exam 7, we cannot assess improvement in diet or weight loss as lifestyle modifications between exam 6 and exam 7.

Participant numbers may not be sufficient to support all planned stratifications in the analysis.

**7.a. Will the data be used for non-ARIC analysis or by a for-profit organization in this manuscript?** \_\_\_\_ Yes \_\_\_x\_\_\_ No

**b. If Yes, is the author aware that the current derived consent file ICTDER05 must be used to exclude persons with a value RES\_OTH and/or RES\_DNA = "ARIC only" and/or "Not for Profit" ?**  Yes  No

(The file ICTDER has been distributed to ARIC PIs, and contains the responses to consent updates related to stored sample use for research.)

**8.a. Will the DNA data be used in this manuscript?**  Yes  No

**8.b. If yes, is the author aware that either DNA data distributed by the Coordinating Center must be used, or the current derived consent file ICTDER05 must be used to exclude those with value RES\_DNA = "No use/storage DNA"?**  Yes  No

**9. The lead author of this manuscript proposal has reviewed the list of existing ARIC Study manuscript proposals and has found no overlap between this proposal and previously approved manuscript proposals either published or still in active status. ARIC Investigators have access to the publications lists under the Study Members Area of the web site at:** <http://www.csc.unc.edu/aric/mantrack/maintain/search/dtSearch.html>

Yes  No

**10. What are the most related manuscript proposals in ARIC (authors are encouraged to contact lead authors of these proposals for comments on the new proposal or collaboration)?**

No overlap was found after searching proposal database

**11.a. Is this manuscript proposal associated with any ARIC ancillary studies or use any ancillary study data?**  Yes  No

**11.b. If yes, is the proposal**

**A. primarily the result of an ancillary study (list number\* \_\_\_\_\_)**

**B. primarily based on ARIC data with ancillary data playing a minor role (usually control variables; list number(s)\* \_\_\_\_\_)**

\*ancillary studies are listed by number <https://sites.csc.unc.edu/aric/approved-ancillary-studies>

**12a. Manuscript preparation is expected to be completed in one to three years. If a manuscript is not submitted for ARIC review at the end of the 3-years from the date of the approval, the manuscript proposal will expire.**

**12b. The NIH instituted a Public Access Policy in April, 2008** which ensures that the public has access to the published results of NIH funded research. It is **your responsibility to upload manuscripts to PubMed Central** whenever the journal does not and be in compliance with this policy. Four files about the public access policy from <http://publicaccess.nih.gov/> are posted in <http://www.csc.unc.edu/aric/index.php>, under Publications, Policies & Forms.

[http://publicaccess.nih.gov/submit\\_process\\_journals.htm](http://publicaccess.nih.gov/submit_process_journals.htm) shows you which journals automatically upload articles to PubMed central.