



Hypertension Research at Sentara Health

June 27, 2025

John Brush, MD., Chief Research Officer, Sentara Health



I do not have any financial COI or ROI to disclose.

Research make us better.

- Clinical trials expose us and our patients to cutting edge therapies.
- Market differentiation, reputation, recruiting.
- We are in the knowledge business.

1. Clinical trials

2. Outcomes research

- Capacity building to do big-data analytics.
- Capacity to manage federally funded research grants.

Two Approaches for Hypertension Research

Aerial View with big data

High tech approach



Boots on the ground

High touch approach



Data Science:

The ability to make data useful

Intentional
study
design

Use
Case

Useful
Data

Accessible
Structured
research-ready

Safely, privately, securely

Organizing data in a common data model

Epic Clarity



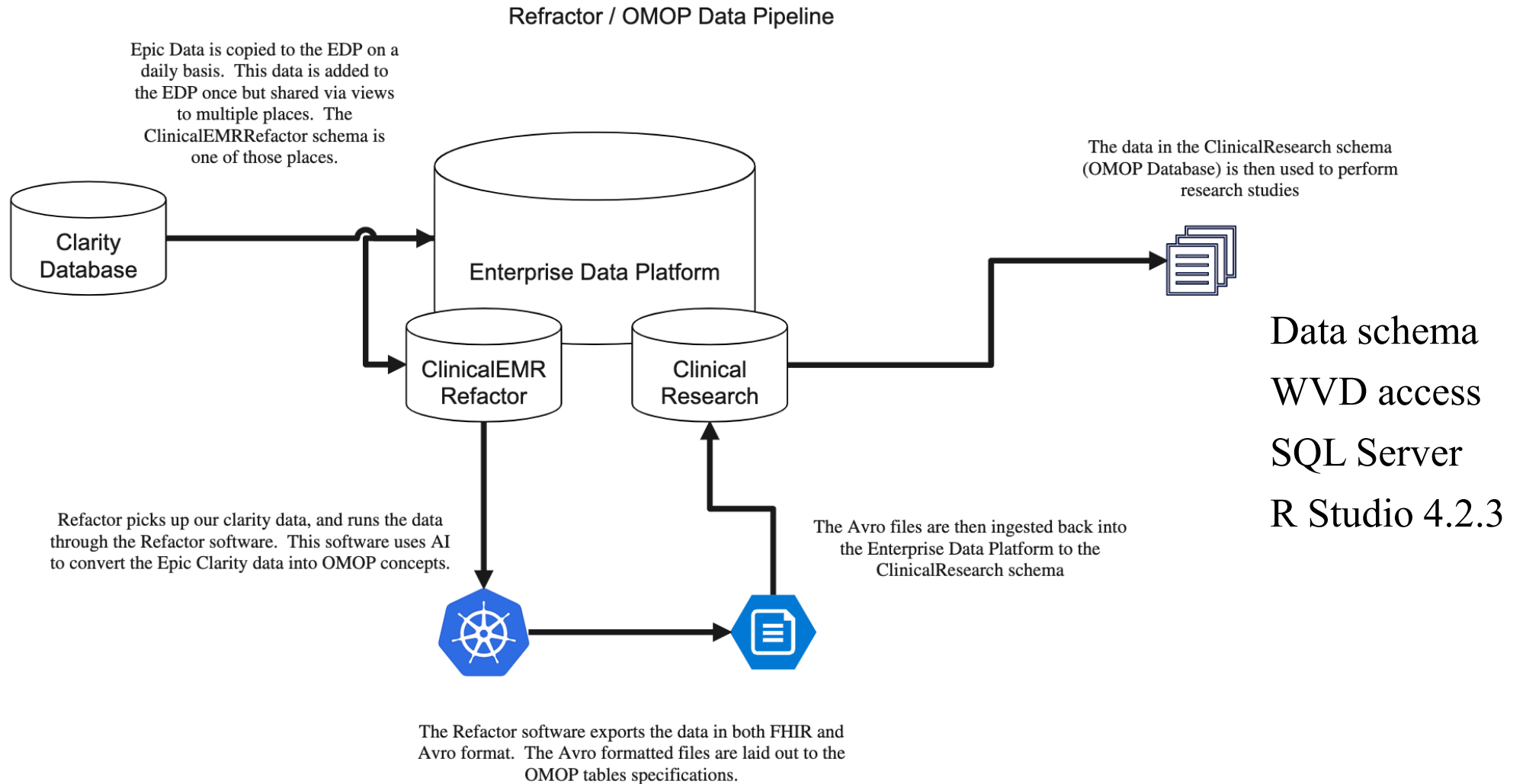
Epic Clarity-20,000 tables

OMOP



Observational Medical
Outcomes Partnership-38 tables

ETL (extract, transform, load) to OMOP



Team Science

Yale Team

- Epidemiologist
- Analysts
- Content Experts



Sentara Team

- IT cloud architect
- Software engineer
- Content Experts



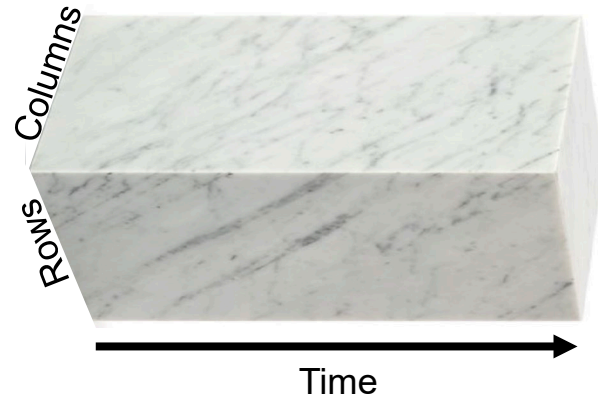
Refactor Engineers



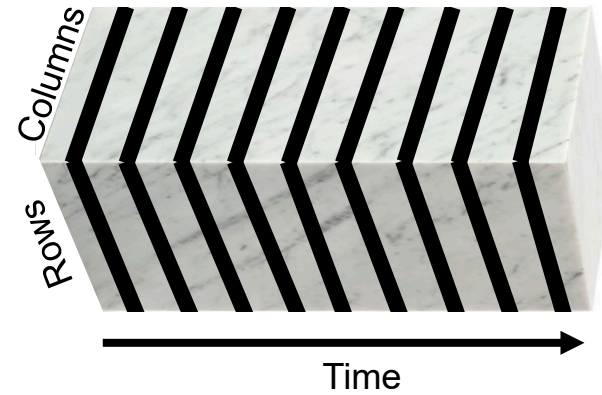
Serial Cross-Sectional Study

Trends over time

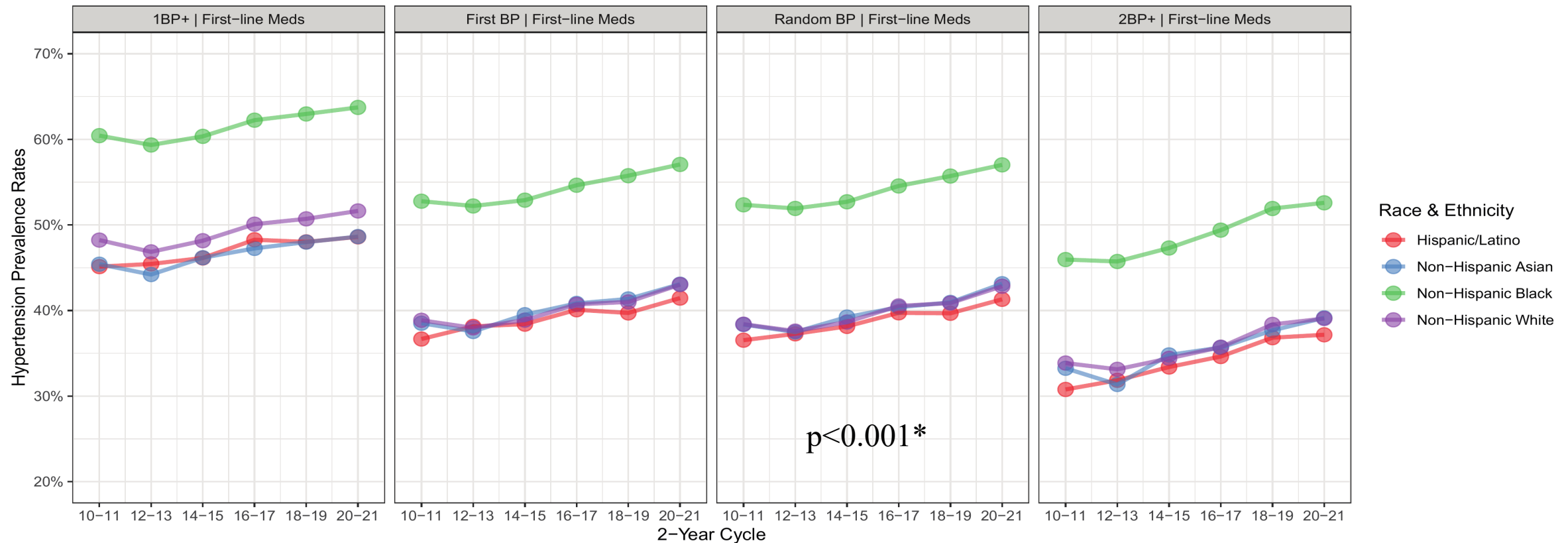
1.7 TB of data over 12
years



Slice into 2-year
segments



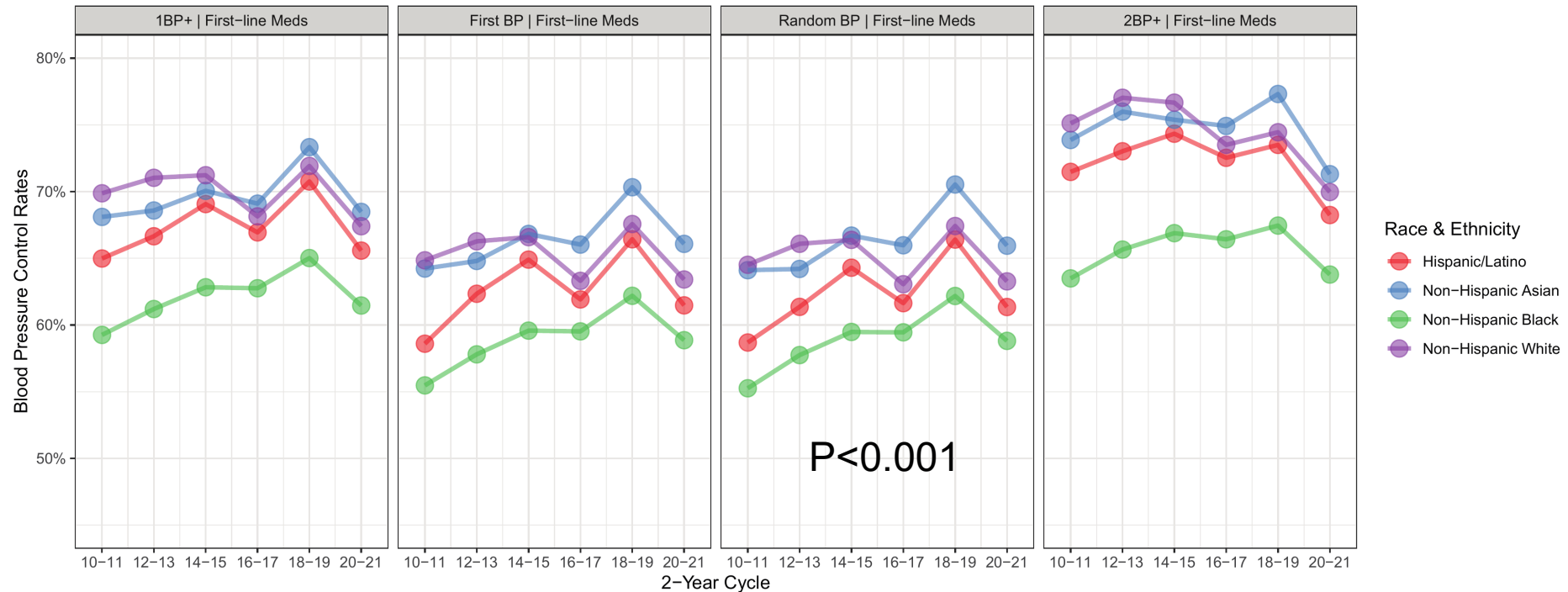
Age-adjusted hypertension prevalence rates by race/ethnicity and operational definition



*By Generalized estimation equation method (GEE).

Accounts for possible unmeasured correlation between observations from different timepoints.

Age-adjusted Control Rates by Race/Ethnicity











JAHA 13 (9): May 2024

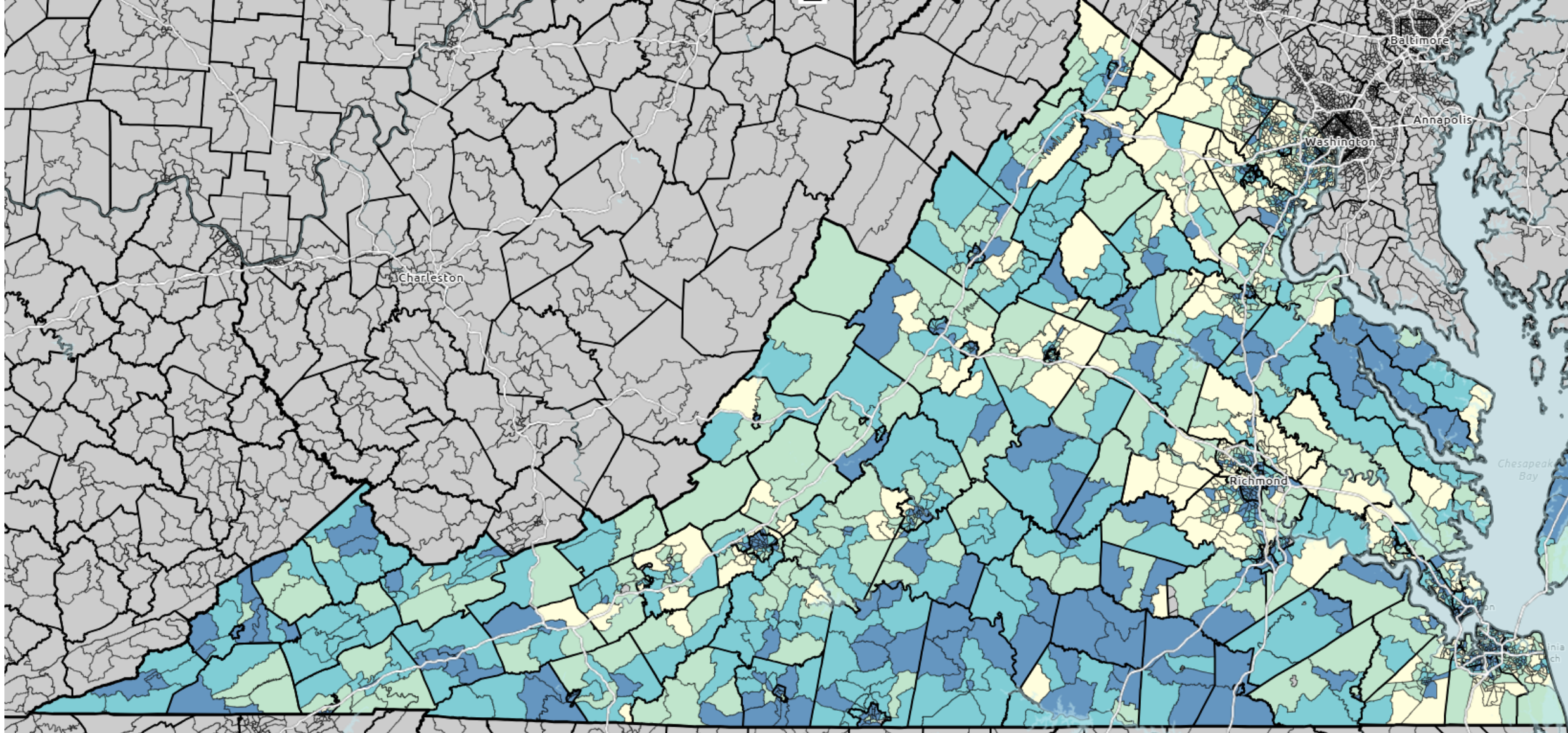
Journal of the American Heart Association

ORIGINAL RESEARCH

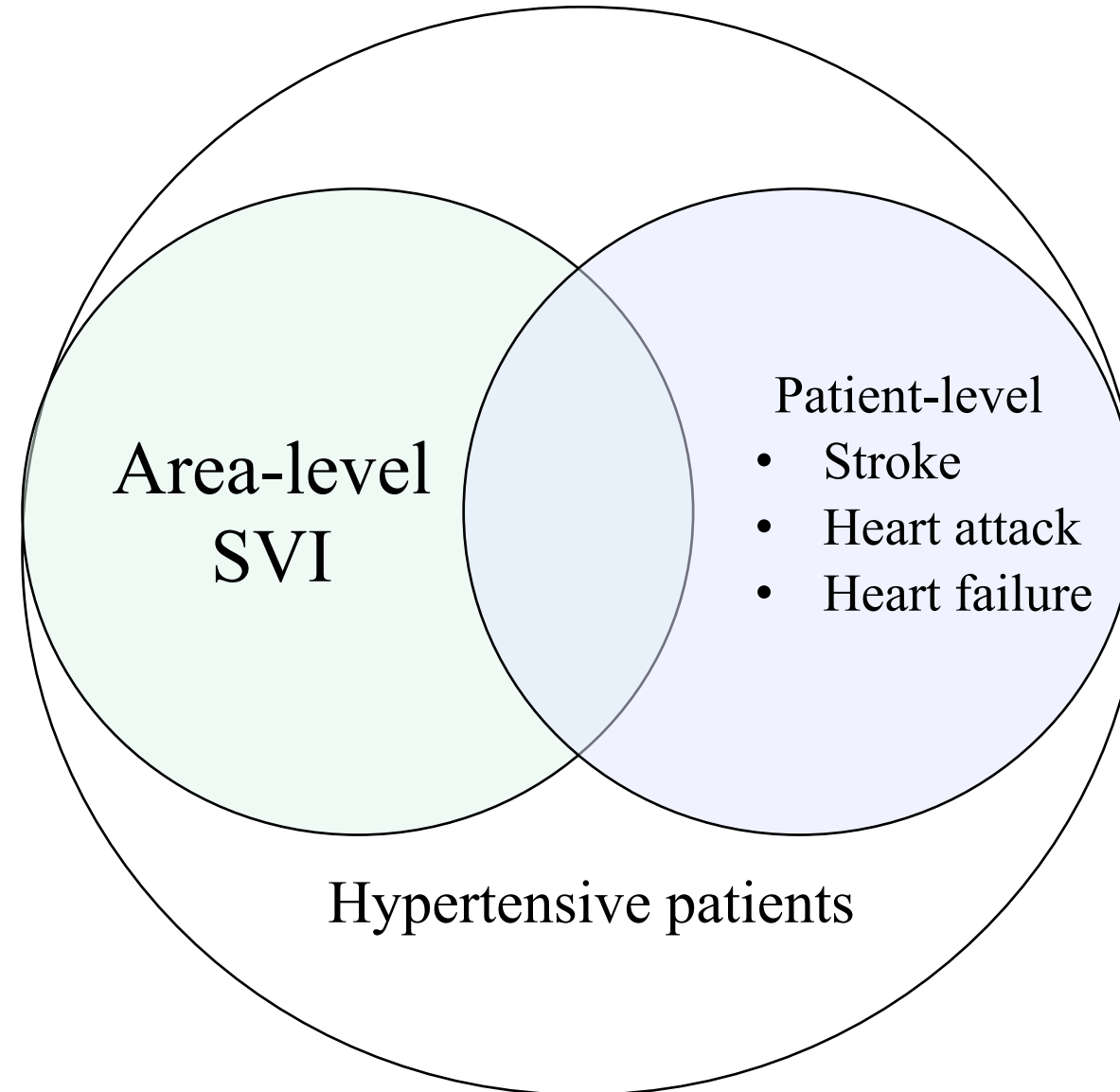
Hypertension Trends and Disparities Over 12 Years in a Large Health System: Leveraging the Electronic Health Records

John E. Brush  Jr, MD^{*}; Yuan Lu , ScD; Yuntian Liu , MPH; Jordan R. Asher , MD, MS; Shu-Xia Li , PhD;
Mitsuaki Sawano , MD; Patrick Young, PhD; Wade L. Schulz , MD; Mark Anderson, AS;
John S. Burrows, MBA; Harlan M. Krumholz , MD, SM

Where you live can affect your health.
Social vulnerability index (SVI), an indicator of SDOH

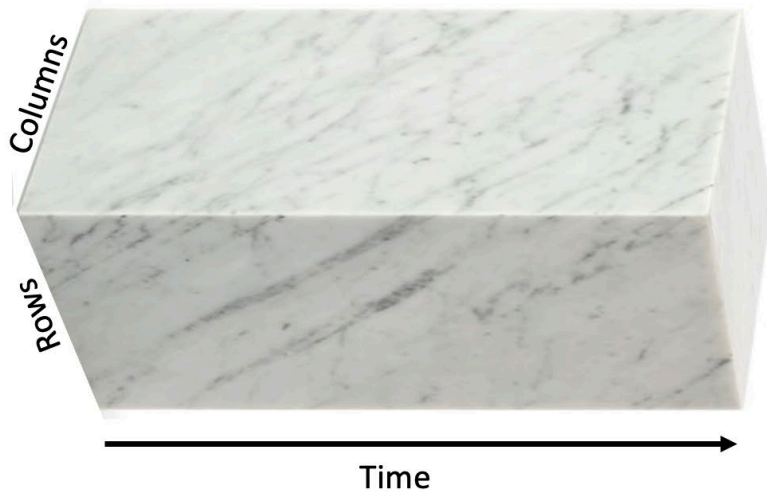


Association between neighborhood level SVI and CV outcomes in hypertensive patients

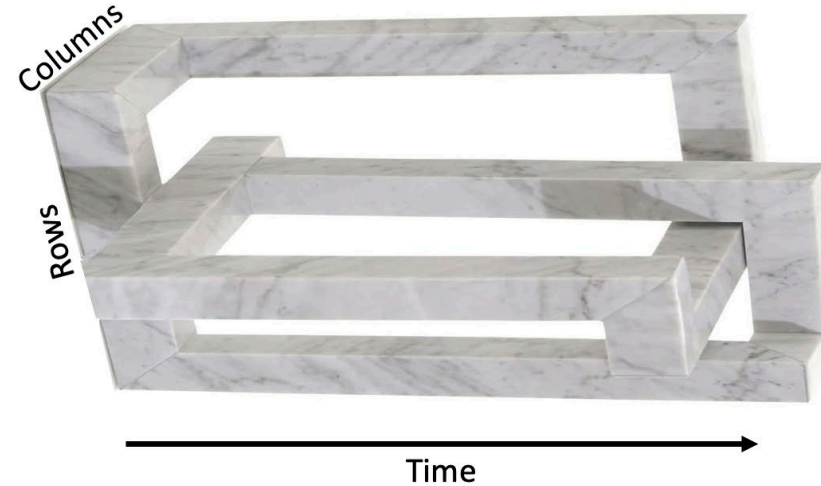


To Predict Outcomes: A longitudinal cohort

1.7 TB of data over 13
years

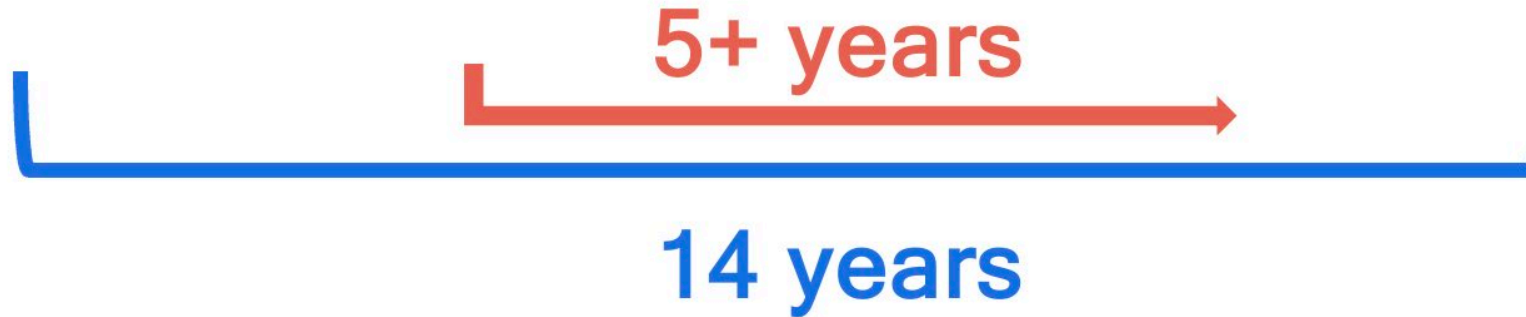


Carve out a
longitudinal cohort



Longitudinal Cohort

of years



of years with visits (RYV)

| | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | | RYV | # Total visits | Avg visits per visit-year |
|---|------|------|------|------|------|------|------|------|------|------|------|------|--|------|----------------|---------------------------|
| A | 1 | 3 | 2 | 3 | 1 | | | | | | | | | 1 | 10 | 2 |
| B | | | | 3 | 2 | | 4 | | 3 | | | | | 4/6 | 12 | 3 |
| C | 1 | | | | | | | | | | | 1 | | 2/12 | 2 | 1 |

Table 1. Baseline characteristics by SVI Quartile
Median follow-up was 6.6 years (IQR=3.9-9.7)

| Characteristics | Total (n = 330972) | SVI Quartile 1 (n = 91393) | SVI Quartile 2 (n = 93632) | SVI Quartile 3 (n = 77331) | SVI Quartile 4 (n = 52096) | SVI missing (n = 16520) |
|------------------------------------|-----------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|----------------------------|
| Age, mean (SD) | 56.95 (15.24) | 58.13 (14.68) | 57.81 (15.16) | 56.11 (15.44) | 54.62 (15.72) | 56.71 (15.27) |
| Male, n (%) | 135255 (40.9) | 40483 (44.3) | 39463 (42.1) | 30030 (38.8) | 18516 (35.5) | 6763 (40.9) |
| Race/Ethnicity, n (%) | | | | | | |
| Hispanic/Latino | 8359 (2.5) | 1819 (2.0) | 2323 (2.5) | 1993 (2.6) | 1856 (3.6) | 368 (2.2) |
| NH Asian | 7364 (2.2) | 2499 (2.7) | 2518 (2.7) | 1511 (2.0) | 691 (1.3) | 145 (0.9) |
| NH Black | 90613 (27.4) | 13408 (14.7) | 19510 (20.8) | 24739 (32.0) | 28046 (53.8) | 4910 (29.7) |
| NH White | 219530 (66.3) | 72175 (79.0) | 67754 (72.4) | 47945 (62.0) | 20839 (40.0) | 10817 (65.5) |
| Others/Unknown | 5106 (1.5) | 1492 (1.6) | 1527 (1.6) | 1143 (1.5) | 664 (1.3) | 280 (1.7) |
| BMI, kg/m ² , mean (SD) | 31.14 (7.25) | 30.21 (6.70) | 30.93 (7.06) | 31.64 (7.48) | 32.29 (7.88) | 31.46 (7.38) |
| SBP*, mmHg, mean (SD) | 131.41 (14.12) | 130.51 (13.40) | 131.29 (13.88) | 131.66 (14.30) | 132.61 (15.25) | 132.12 (14.43) |
| DBP*, mmHg, mean (SD) | 78.36 (9.24) | 77.96 (8.85) | 78.17 (9.14) | 78.56 (9.34) | 79.04 (9.86) | 78.58 (9.21) |

*Blood pressure measured at an office/outpatient settings. SVI: social vulnerability index; SD: standard deviation, n: number; NH: non-Hispanic; BMI: body mass index; SBP: systolic blood pressure; DBP: diastolic blood pressure; ADI: area deprivation index.

Kaplan Meier curves by SVI quartile

Overall SVI Theme 1

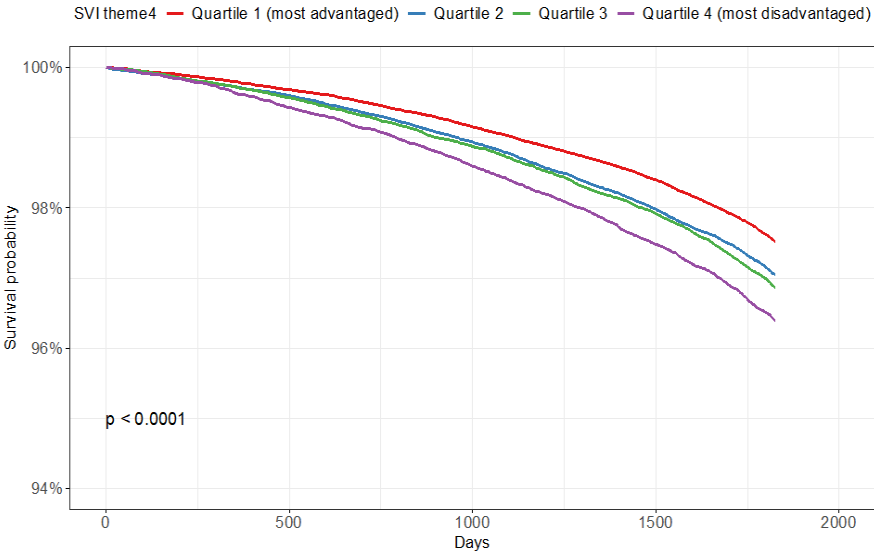
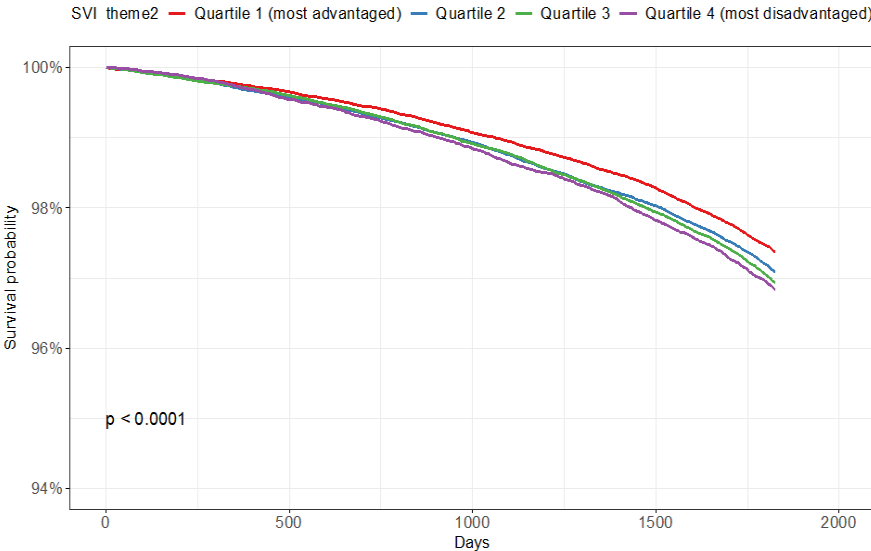
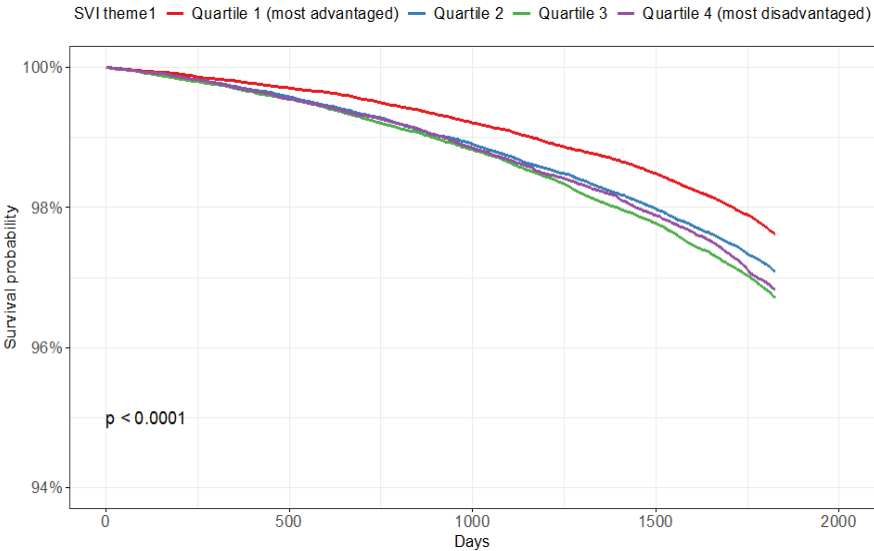
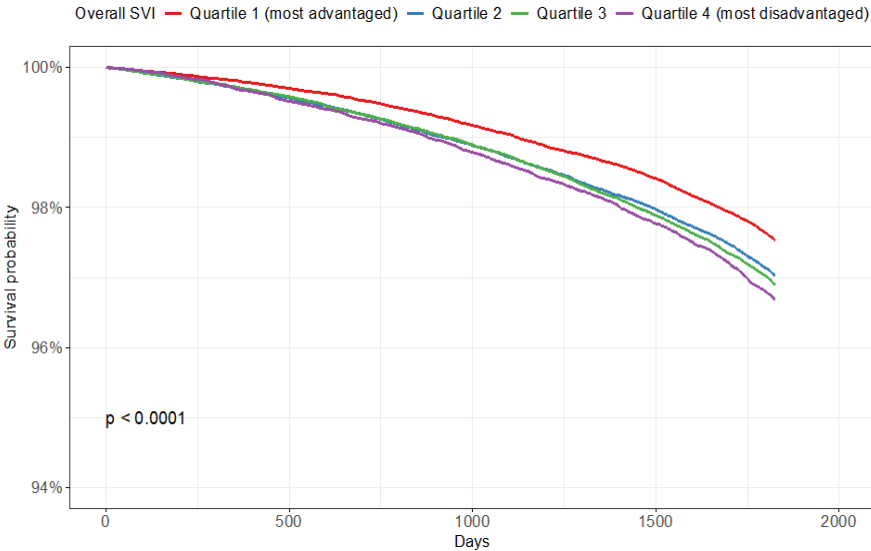
Socioeconomic status

Theme 2

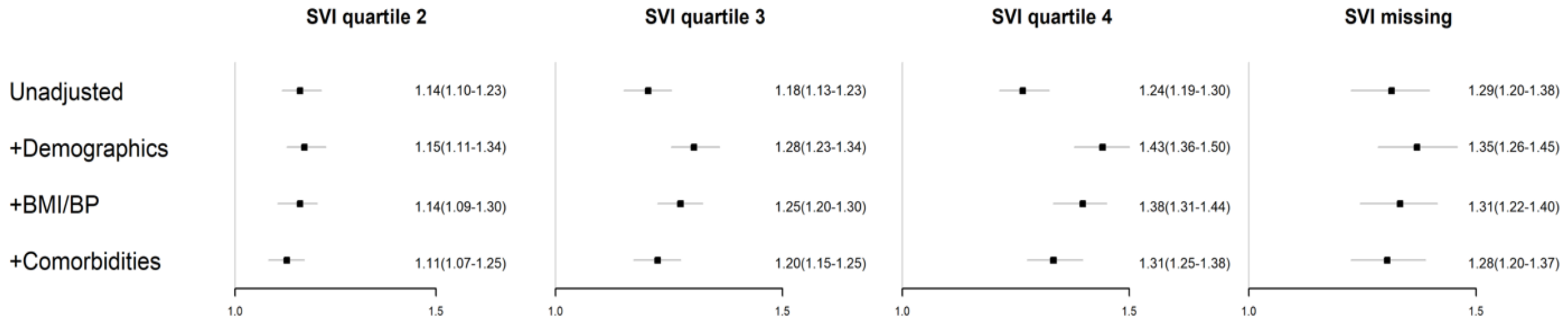
Household characteristics

Theme 4

Housing type and transportation

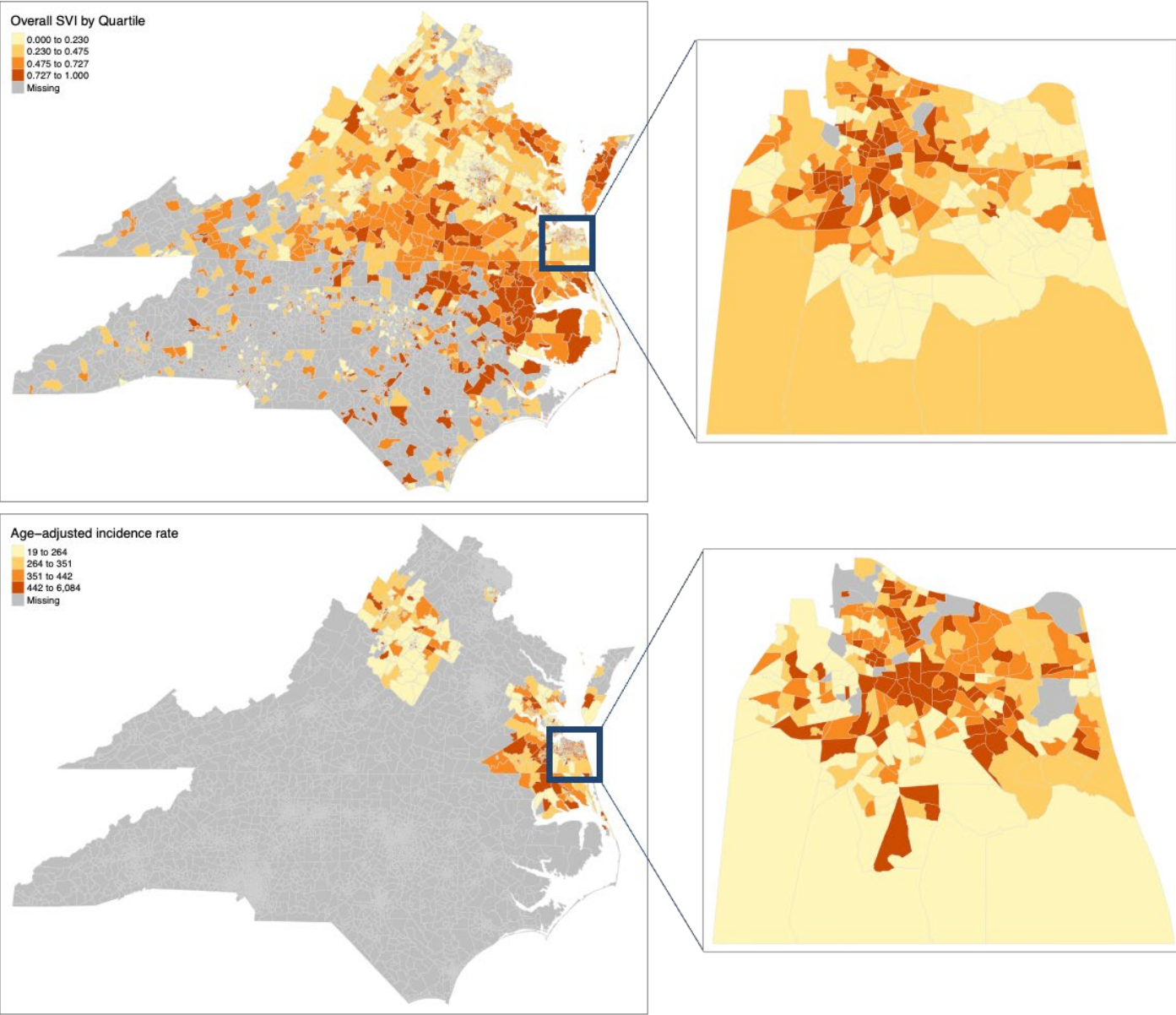


Unadjusted and sequentially adjusted Cox Models for association between SVI quartile and the composite endpoint (MI, CHF, CVA).



Top panel-SVI

Bottom panel-outcome



Findings

- The SVI is strongly associated with CV complications in a large diverse cohort of hypertensive patients.
- Addressing area-level social vulnerability may be important for identifying high-risk hypertensive patients who may benefit from more intensive interventions.
- Health systems could use this information to target vulnerable areas, then identify high-risk individuals within those areas as a strategy to address racial disparities and improve cardiovascular outcomes in hypertensive patients.

Accepted for Publication



Journals ▾

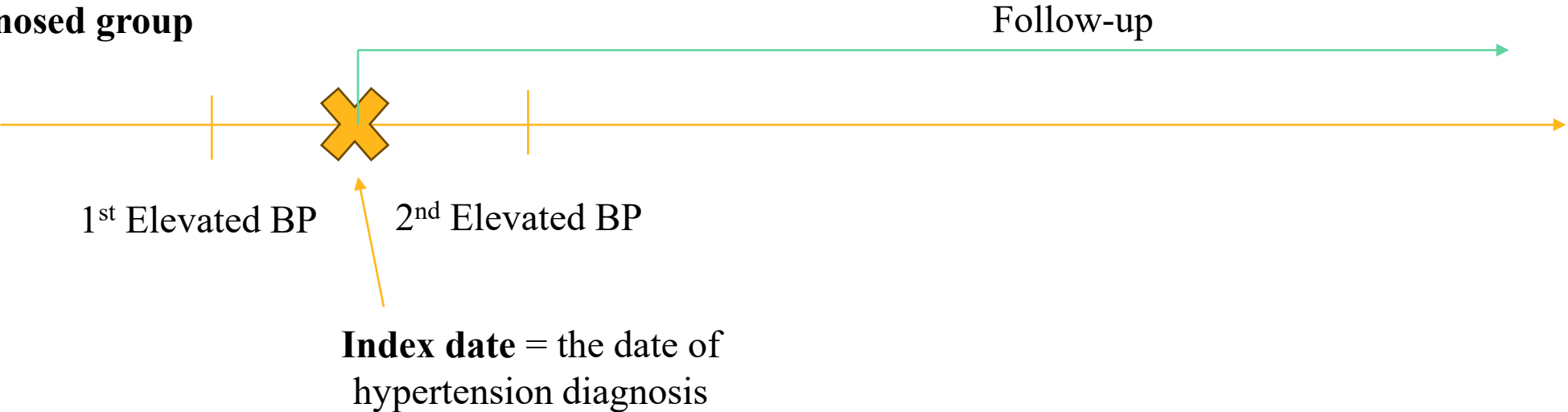
Topics ▾

Guidelines ▾

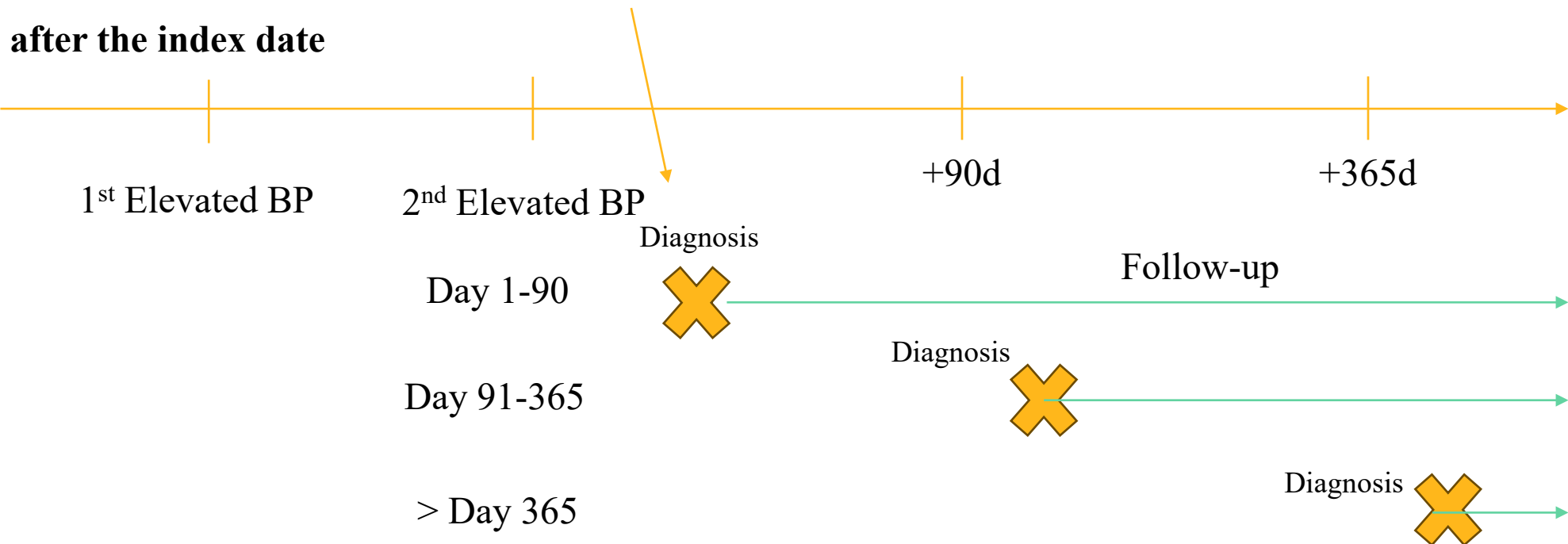
JACC: Advances

Effect of diagnostic delay?

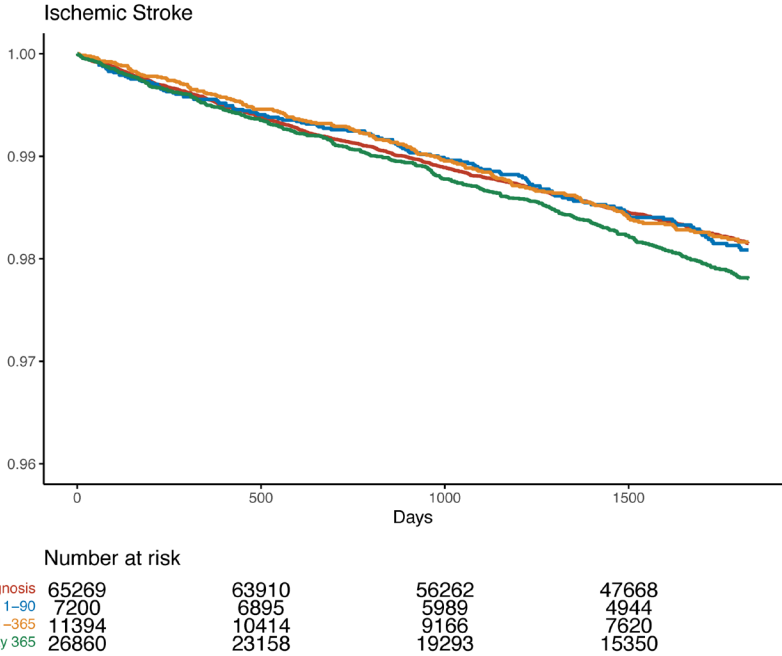
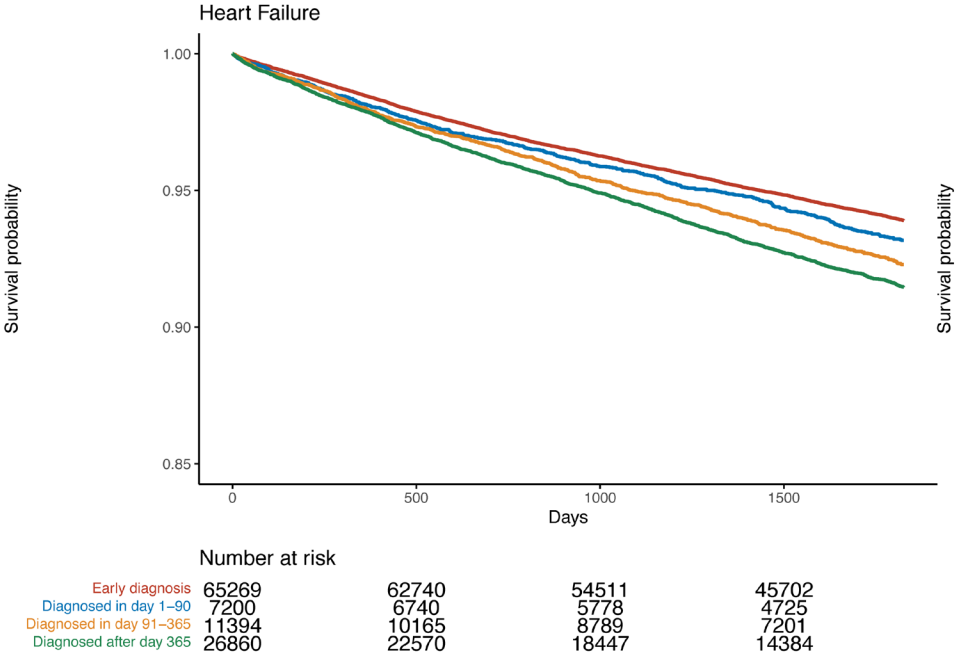
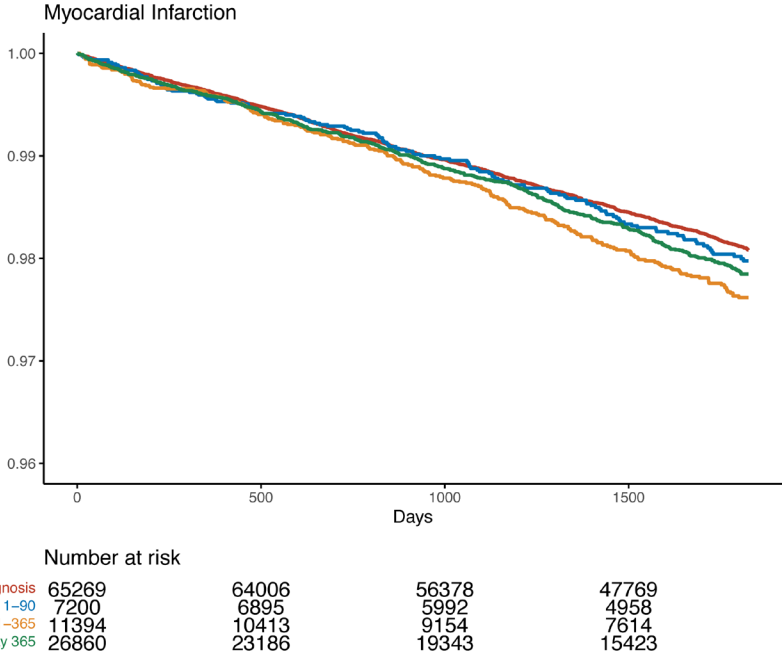
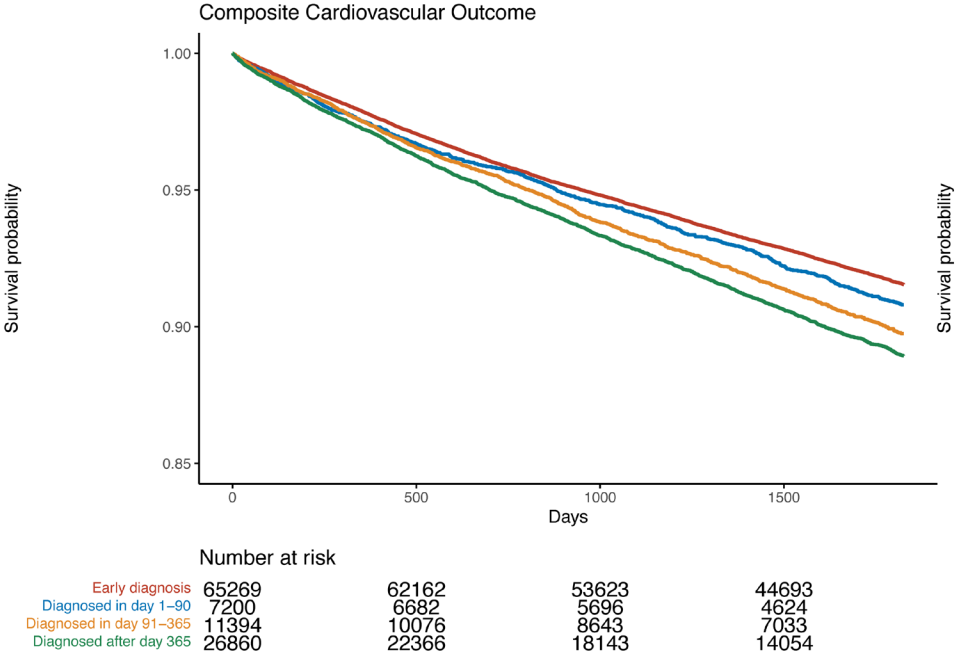
Early diagnosed group



Diagnosed after the index date



Event-free Survival



Accepted for Publication

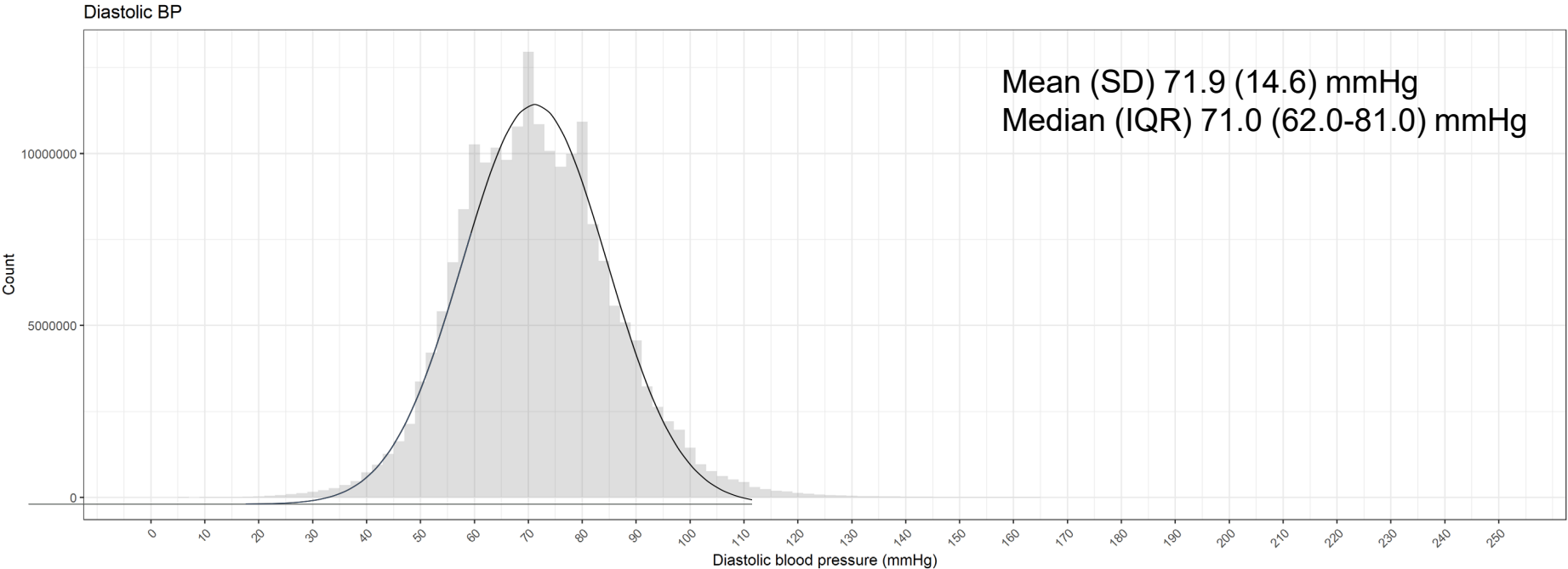
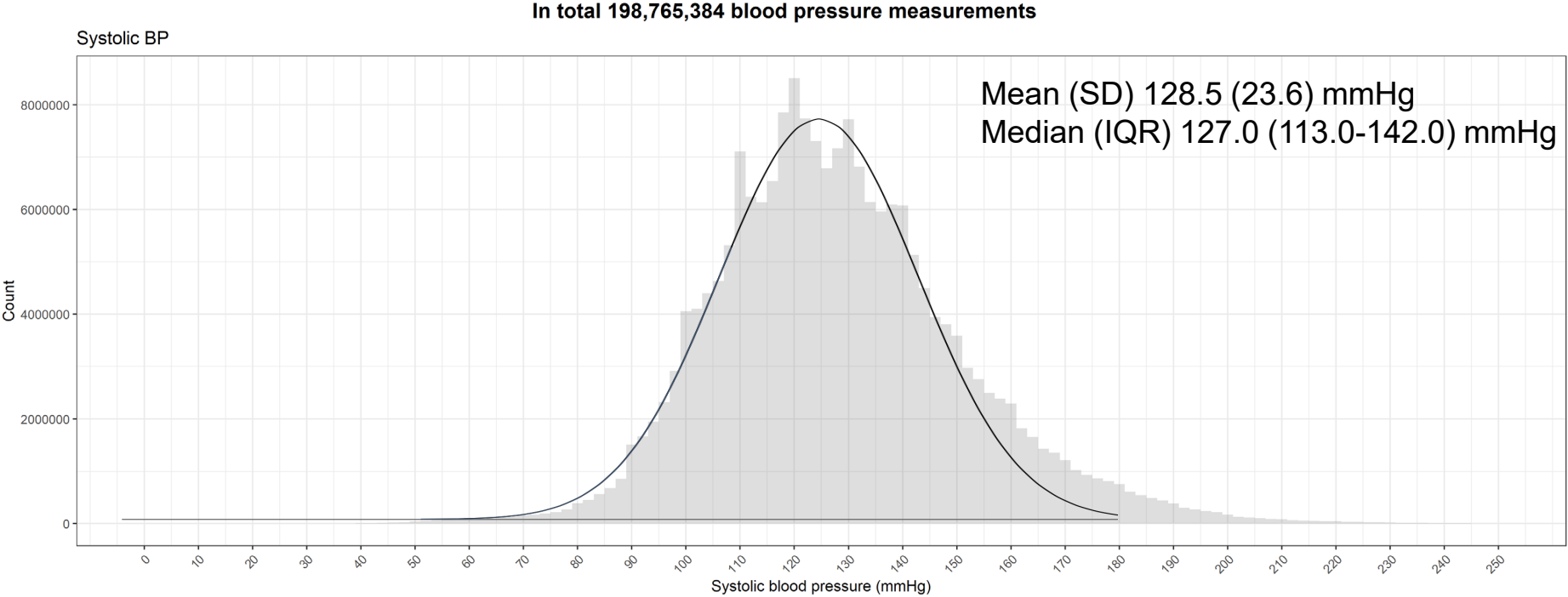


Original Investigation | Cardiology

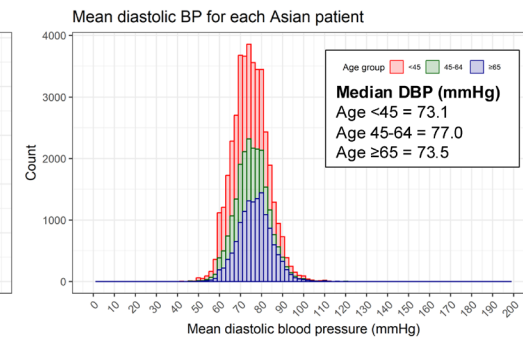
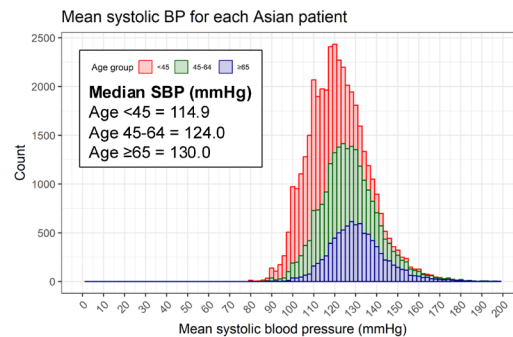
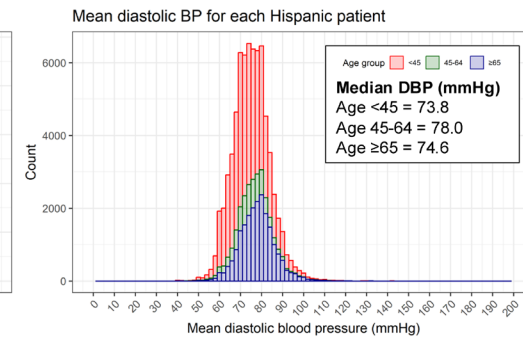
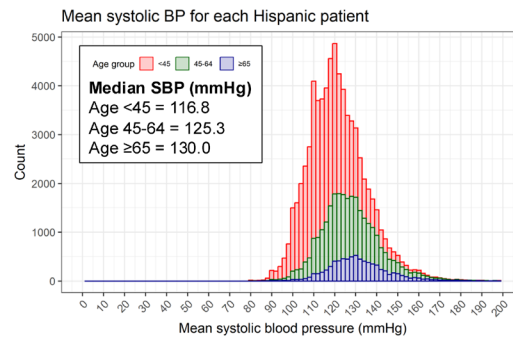
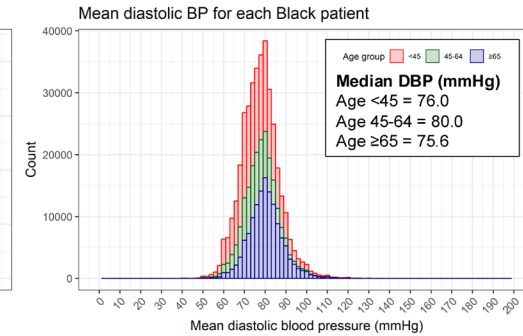
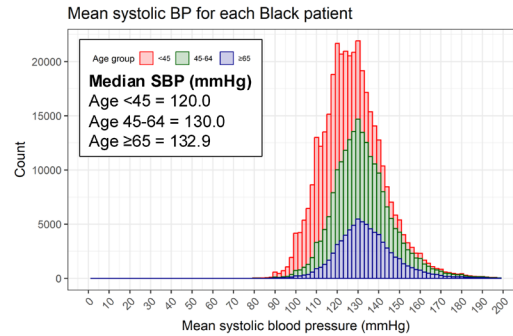
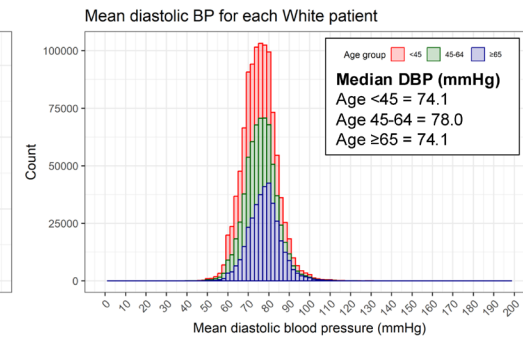
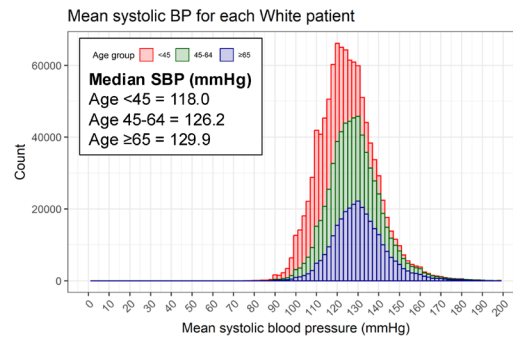
Delayed Hypertension Diagnosis and Its Association with Cardiovascular Treatment and Outcomes

Yuan Lu, ScD; John E. Brush Jr, MD; Chungsoo Kim, PharmD, PhD; Yuntian Liu, MPH; Xin Xin, MS; Chenxi Huang, PhD; Mitsuaki Sawano, MD; Patrick Young, PhD; Jacob McPadden, MD; Mark Anderson, AS; John S. Burrows, MBA; Jordan R. Asher, MD, MS; Harlan M. Krumholz, MD, SM

Blood pressure Distributions



Distribution of all outpatient BPs averaged by individual for 1,529,320 patients by race/ethnicity.



Current project:

Case control study of hypertensive patients who had an ischemic stroke

| A Cohort Study | | |
|--------------------------|-------------|---------------|
| | Outcome | |
| | Yes | No |
| Exposed | a | b |
| Not exposed | c | d |
| → Direction of Inquiry → | | |
| A Case Control Study | | |
| | Yes (cases) | No (controls) |
| Exposed | a | b |
| Not exposed | c | d |
| ← Direction of Inquiry ← | | |

Two Approaches for Hypertension Research

Aerial View with big data

High tech approach



Boots on the ground

High touch approach



PCORI Grant to Study Hypertension in Vulnerable Populations



MASSACHUSETTS
GENERAL HOSPITAL

Study Aims: determine whether remote blood pressure monitoring and community health workers improve blood pressure control in vulnerable patients.

Community Based Organizations

Second Calvary Baptist Church

Norfolk, Virginia

Pastor Geoffrey Guns

New Hope Church of God in Christ

Norfolk, Virginia

Pastor Calvin Durham

The Mount Global Fellowship of Churches

Virginia Beach, Virginia

Pastor Terron Rodgers

Rehoboth Baptist Church

Virginia Beach, Virginia

Pastor James Allen

Faith Deliverance Christian Center

Norfolk, Virginia

Pastor Sharon Riley

Historic First Baptist Church

Norfolk, Virginia

Pastor Jerry Holmes

Ebenezer Baptist Church

Virginia Beach, Virginia

Pastor Perez Gatling

Gethsemane Baptist Church

Newport News, Virginia

Pastor Dwight Riddick Sr.

Sixth Mount Zion Baptist Temple

Newport News, Virginia

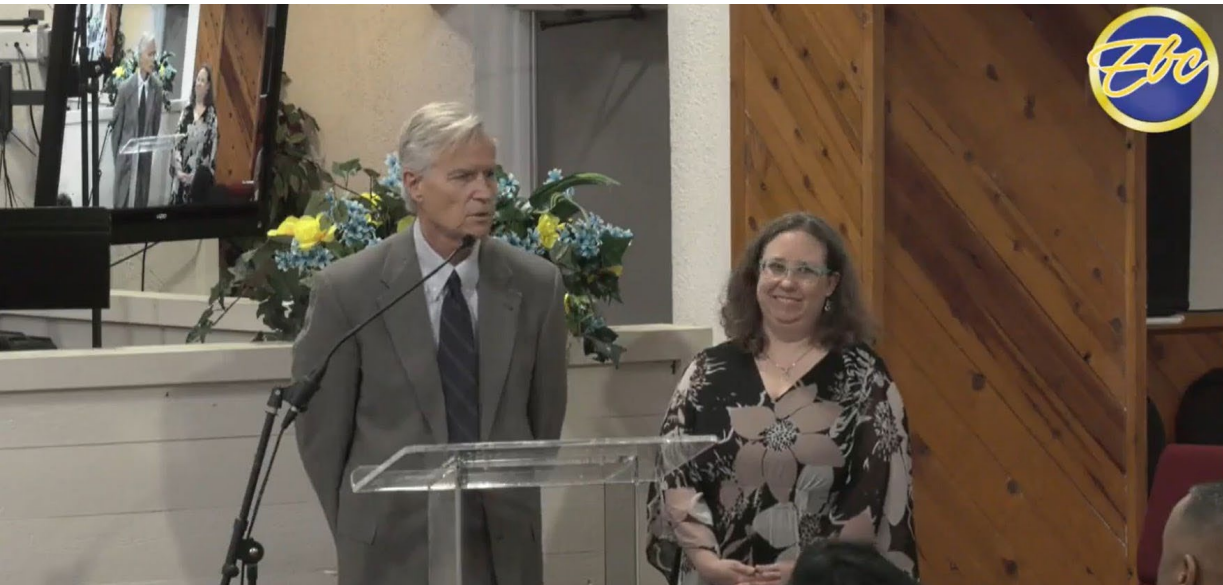
Pastor Jerome Barber

New Beech Grove Baptist Church

Newport News, Virginia

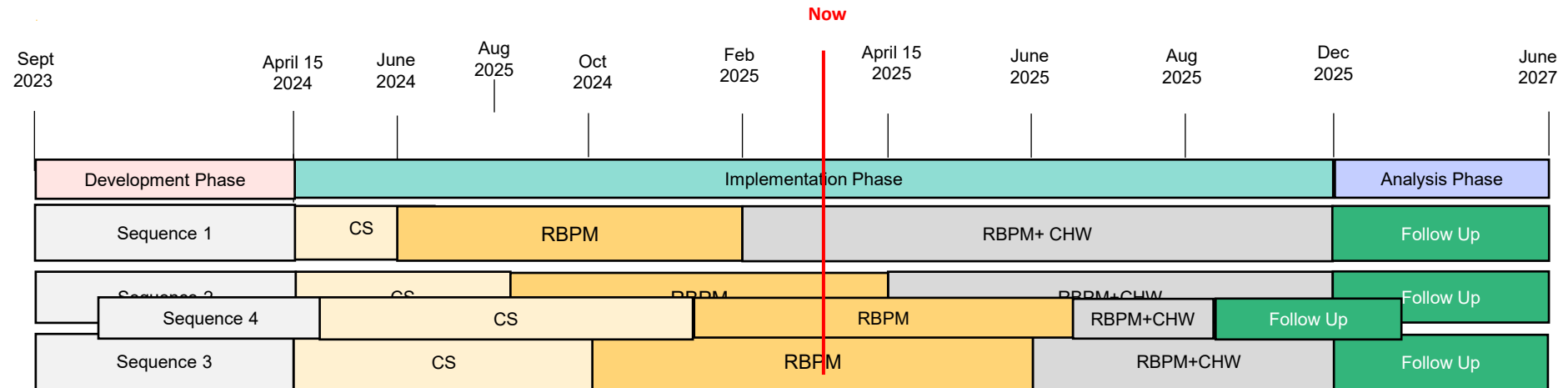
Pastor Willard Maxwell

Visits to churches



Timeline


Step-Wedge Study Design



Definitions

- ^a Standard of care: Visit Primary Care Physician after screening positive for hypertension at community-based organization
- ^b RBPM: Standard of care PLUS home blood pressure (BP) monitoring, weekly virtual visits for 6 months by a physician extender (e.g. RN, pharmacist, etc),
- ^c CHW: Standard of care PLUS RBPM PLUS utilizing community health workers and screening for social determinants of health with referral for services if screened positive

WAVY news segment



ON YOUR SIDE
WAVY.com


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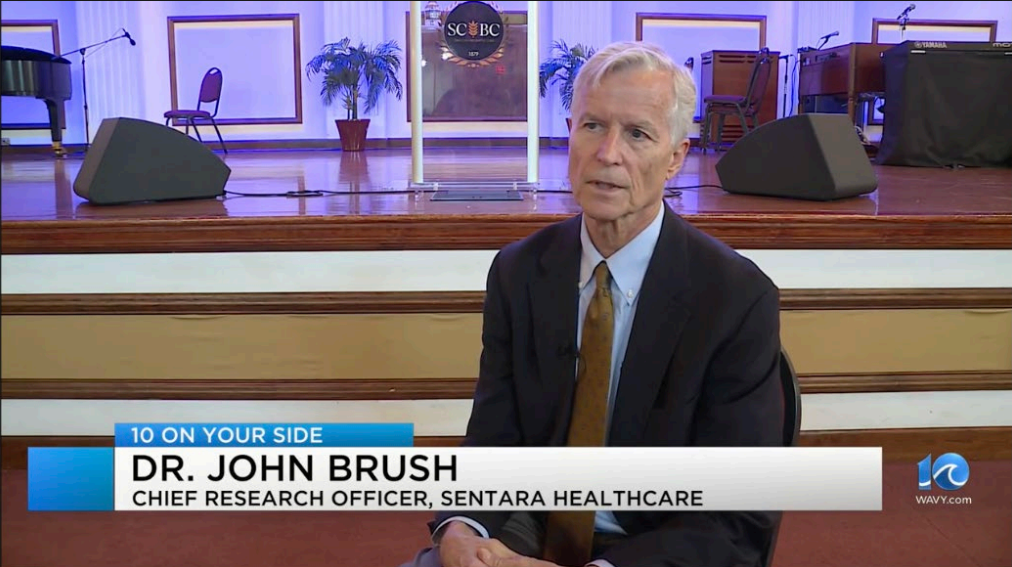
Q Search

HEALTH

Sentara partners with local churches to study hypertension


by: [Amy Avery](#)
Posted: May 29, 2024 / 06:23 PM EDT
Updated: May 29, 2024 / 06:23 PM EDT






10 ON YOUR SIDE


DR. JOHN BRUSH
CHIEF RESEARCH OFFICER, SENTARA HEALTHCARE





10 ON YOUR SIDE

REV. DR. GEOFFREY GUNS
SECOND CALVARY BAPTIST CHURCH



Hypertension Research at Sentara

- Prevalence is increasing.
- Prevalence is 12-14% higher in Black patients.
- Area level SVI is strongly associated with cardiovascular outcomes in hypertensive patients.
- Black patients comprised 54% of the most vulnerable census tracts.
- Delay in hypertension diagnosis has consequences.
- Sentara is working with community-based organizations to examine ways to improve hypertension control and outcomes.

Conclusion

Research makes us better.

- Creativity: generating something that is new and useful.
 - **New thing is a thing>innovation**
 - Sentara's capacity to do data science research.
 - **New thing is generalizable knowledge>research**
 - Neighborhood level social vulnerability = worse hypertension outcomes.
- Curiosity: being open to new things, willing to ask questions.

Questions?

John Brush, MD., Chief Research Officer, Sentara Health

