VIReC Database & Methods Cyberseminar Series

Blood pressure measurements and their application for outcomes research using the CDW

April 6, 2015

Presented by: Csaba P Kovesdy, MD

Memphis VA Medical Center

University of Tennessee Health Science Center

Objectives

- Review the blood pressure (BP) measurement variable in the VA database: location, file structure, ancillary variables, and availability.
- Examine practical aspects of analyzing blood pressure in the VA database
- Discuss studies examining blood pressure in the VA database

Poll Question 1

What is your primary role in the VA?

- Primary Care/Specialty Provider
- Mental Health Provider
- Nurse
- Researcher
- Administrator

Poll Question 2

What is your experience with using blood pressure in research?

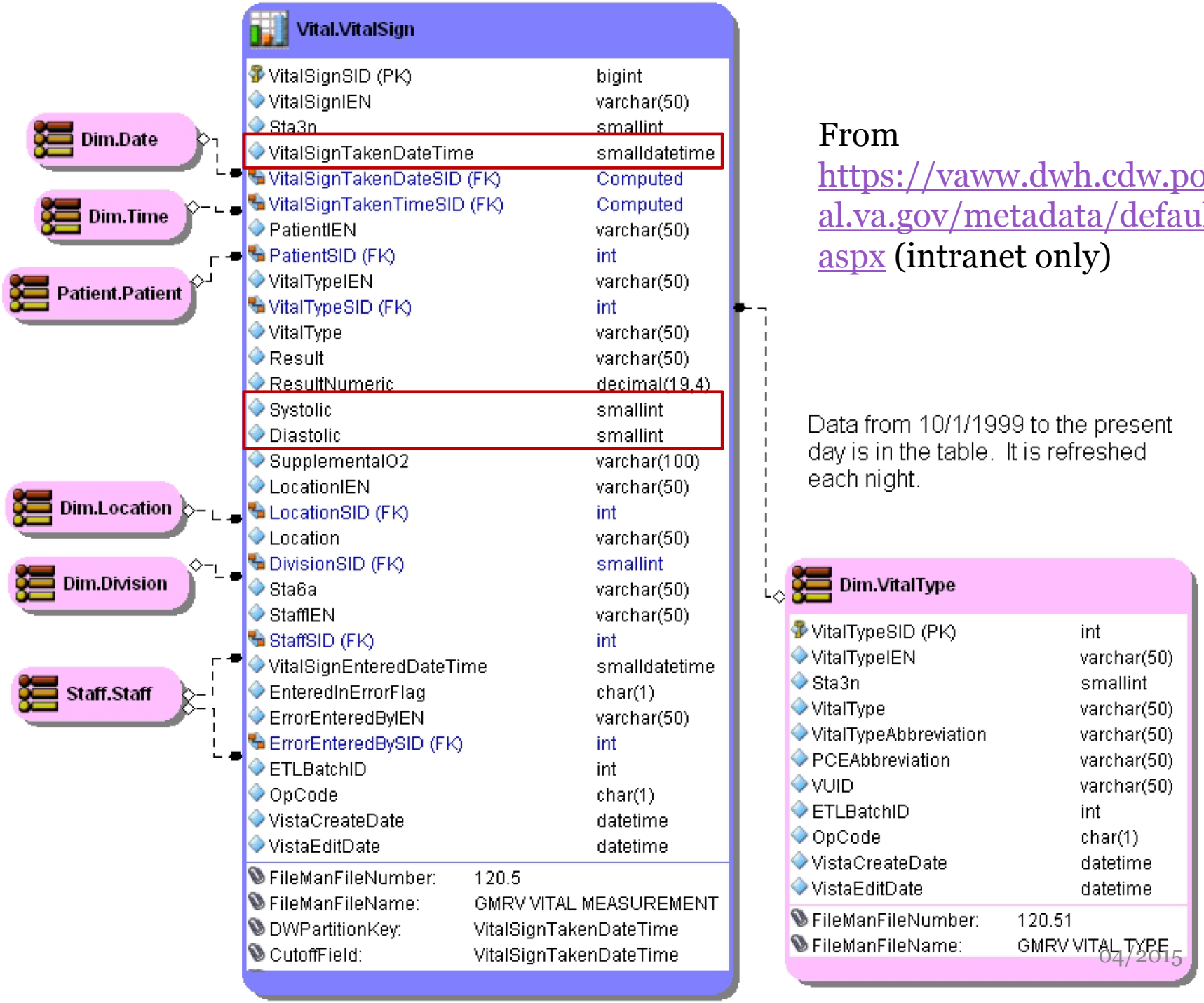
- heard of it, but no experience using it
- I have experience using it
- Not heard of it/no experience using it

Background

- BP is measured on virtually all veterans receiving clinical care
- Hypertension (usually defined as BP >140/90 mmHg) is the number one risk factor for cardiovascular morbidity and mortality worldwide
- The large number of BP measurements offer a unique opportunity for outcomes research

Vital Signs Domain

- Corporate Data Warehouse (CDW) contains the Vital signs from all sites since 10/1/1999
- There are about 2 billion records in CDW Vitals
- Data refreshed each night
- Linked tables



From https://vaww.dwh.cdw.portal.va.gov/metadata/default.aspx (intranet only)

Data from 10/1/1999 to the present day is in the table. It is refreshed each night.

Vitals Metadata

Table	Description
Vital.VitalSign	Extracted from VistA file 120.5 (GMRV Vital Measurement) vital sign main table
Dim.VitalType	Extracted from VistA file 120.51 (GMRV Vital Type). description of each vital type, such as blood pressure, height, and weight.

from the table descriptions in the CDW SharePoint metadata report page: https://vaww.dwh.cdw.portal.va.gov/metadata/default.aspx (intranet only)

Data Profile Information

VitalType	Count*
PAIN	363,475,783
VENTILATOR MINUTE VOLUME	86,704
VENTILATOR TIDAL VOLUME	86,780
BLOOD PRESSURE	369,612,858
VENTILATOR MODE	42,670
ABDOMINAL GIRTH	6
CENTRAL VENOUS PRESSURE	523,754
CIRCUMFERENCE/GIRTH	1,000,887
PAR SCORE (TOTAL)	12
PULSE	344,803,275
PULSE OXIMETRY	95,485,935
RESPIRATION	293,103,643
TEMPERATURE	287,732,921
VENTILATOR SET RATE	93,957
VENTILATOR TYPE	25,381
WEIGHT	166,764,666
COMFORTABLE	2,091
HEIGHT	84,513,025
NEURO SCORE (TOTAL)	915
TONOMETRY	1

*As of 4/14/2011

Vital count by vital sign taken time (as of 4/14/2011)

year	COUNT
1999	17,621,641
2000	88,546,955
2001	118,618,196
2002	136,863,428
2003	151,492,548
2004	170,857,625
2005	179,043,552
2006	187,742,801
2007	199,041,438
2008	213,611,584
2009	231,871,358
2010	241,107,433
2011	70,938,108

Limitations

- There is no unit of measure with each type of vital
  - Height is measured in inches,
  - weight in pounds,
  - respiration in breaths per minute,
  - pain from 1 to 10 (10 being maximum),
  - pulse in beats per minute,
  - temperature in degrees Fahrenheit
- CDW does not have vital qualifiers, which record things like the arm from which the blood pressure was taken.

For More Information

VINCI Data Description
http://vaww.vinci.med.va.gov/vincicentral/documents/Data_Descriptions/Vital_Signs_Data_Description.pdf (intranet only)

CDW SharePoint Metadata Report
https://vaww.dwh.cdw.portal.va.gov/metadata/default.aspx (intranet only)

Data Architecture Repository for VistA Metadata
http://enterprise.metadata.va.gov/pls/apex/f?p=VISTA:1:7049284742385600::::: (intranet only)

VIReC CDW Data Documentation
http://vaww.virec.research.va.gov/CDW/Documentation.htm (intranet only)

VIReC
RESEARCHERS' GUIDE TO VA DATA

Practical aspects

- Data cleaning: systolic BP (SBP) and diastolic BP (DBP)
  - Biologic plausibility
    - No uniform rule for what is acceptable
    - SBP >300 mmHg unlikely
    - DBP >200 mmHg unlikely
    - No rule for plausibility of lowest values
    - Zero value not possible
    - SBP always > than DBP
    - SBP always accompanied by DBP

Practical aspects (2)

- Date/time of BP measurement
  - Format: YMD hms
  - Often multiple measurements within the same day: may require distinctly different analytic approach
    - Hospitalizations (inpatient/outpatient status)
    - Multiple outpatient visits on same day
    - Repeated BP measurements during same outpatient visit

Poll Question 3

What is the ideal target blood pressure in patients with essential hypertension?

- <130/80 mmHg
- <140/90 mmHg
- 130-140/80-90 mmHg
- <120/80 mmHg

Poll Question 4

Elevated blood pressure is associated with adverse outcomes in which populations?

- All populations
- In those with no comorbidities
- In advanced chronic heart failure
- In patients on hemodialysis

BP and mortality: Background

- High BP causes adverse outcomes
- Treating elevated BP is beneficial
- Treatment targets focus on highest of two BP component
  - 160/70 mmHg: lower SBP to <140 mmHg
  - 140/100 mmHg: lower DBP to <90 mmHg
- J-shape phenomenon often described
  - Low SBP and DBP also associated with higher mortality
  - SBP and DBP change in tandem upon therapy
- Treatment targets less well defined for patients with CKD

Annals of Internal Medicine | ORIGINAL RESEARCH

Blood Pressure and Mortality in U.S. Veterans With Chronic Kidney Disease

A Cohort Study

Csaba P. Kovesdy, MD; Anthony J. Bleyer, MD; Miklos Z. Molnar, MD, PhD; Jennie Z. Ma, PhD; John J. Sim, MD; William C. Cushman, MD; L. Darryl Quarles, MD; and Kamyar Kalantar-Zadeh, MD, PhD

Ann Intern Med. 2013;159:233-242.

BP and mortality in US Veterans

- From 4,381,049 patients with an eGFR between October 1, 2004 and September 30, 2006 we analyzed 651,749 patients with non-dialysis dependent CKD.

Kovesdy et al, *Ann Intern Med* 2013;159(4):233-42

Methods

- Information on all outpatient BP measurements over a 7 year period was obtained from the VA Corporate Data Warehouse.
- Information on age, gender, race, co-morbidities and laboratory data was obtained from the VA Corporate Data Warehouse, Medical SAS Datasets and Decision Support System.
- Information about all-cause deaths was obtained from the VA Vital Status Files.

Kovesdy et al, *Ann Intern Med* 2013;159(4):233-42

Methods

- SBP and DBP were examined separately as continuous variables. Non-linearity was explored by using splines.
- Actual BP was examined by
  - Categorizing patients according to JNC-7 hypertension definitions: normal, pre-hypertension, stage 1 and stage 2 hypertension.
  - Categorizing patients by mutually exclusive combinations of SBP categories (15 categories from <80 to ≥210 mmHg) and DBP categories (10 categories from <40 to ≥120 mmHg).
- Crude all-cause mortality rates were examined in time-dependent Cox models.
- Multivariable models were generated with sequential adjustment for confounders.
- Blood pressure and lab results were handled as time-dependent variables.

Kovesdy et al, *Ann Intern Med* 2013;159(4):233-42

Results

- The mean±SD age of the cohort was 72.9±9.8 years and the mean eGFR was 50.4±14.4 ml/min/1.73m^2.
- The mean±SD SBP and DBP at baseline were 135±18 and 72±11 mmHg, respectively.

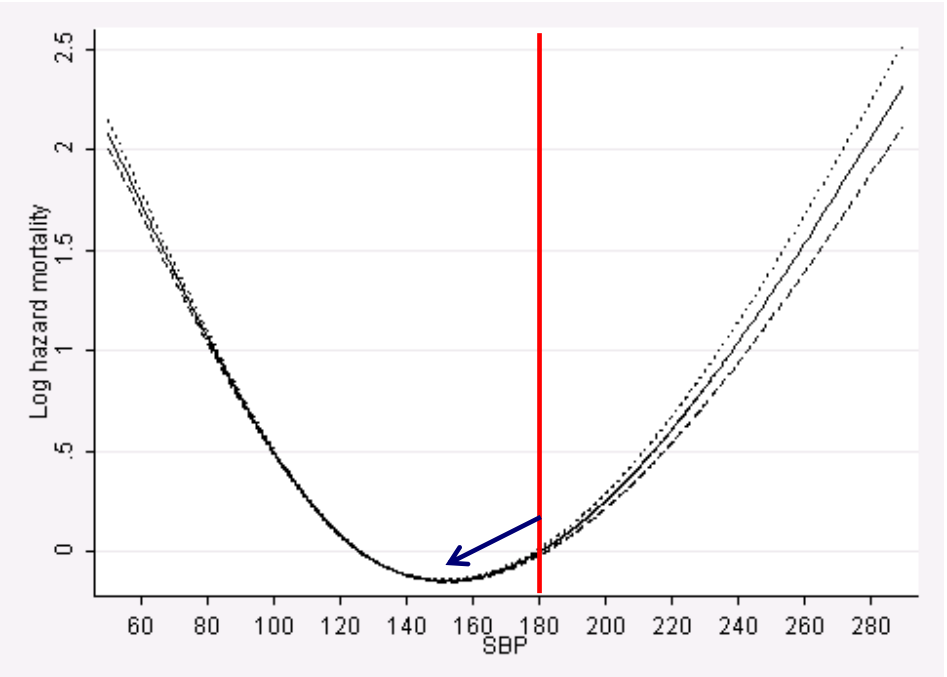
Kovesdy et al, *Ann Intern Med* 2013;159(4):233-42

	SBP <120 and DBP <80 (N=132,249)	SBP 120-139 or DBP 80-89 (N=295,937)	SBP 140-159 or DBP 90-99 (N=169,416)	SBP ≥160 or DBP ≥100 (N=54,147)
Age (years)	74.0±9.8	73.8±9.7	73.8±9.7	73.9±10.0
Gender (N, % females)	3,042 (2.6)	7,960 (2.7)	4,637 (2.7)	1,634 (3.0)
Race (N, % blacks)	9,190 (7.0)	25,093 (8.6)	18,748 (11.2)	7,852 (14.7)
BMI (kg/m^2)	28.7±5.7	29.4±5.7	29.6±5.8	29.5±6.0
DM (N, %)	54,288 (41.1)	126,035 (42.6)	76,171 (45.0)	25,453 (47.0)
Cardiovascular disease (N, %)	66,940 (50.6)	123,970 (41.9)	66,144 (39.1)	20,749 (38.3)
Cerebrovascular disease (N, %)	19,774 (15.0)	42,019 (14.0)	25,975 (15.3)	9,227 (17.0)
CHF (N, %)	28,409 (21.5)	39,742 (13.4)	20,042 (11.8)	6,689 (12.3)
Charlson index	3.8±1.9	3.7±1.9	3.7±1.9	3.7±1.9
ACEI/ARB use (N, %)	69,013 (52.2)	153,162 (51.8)	94,649 (55.9)	33,156 (61.2)
Ca channel blocker use (N, %)	31,932 (24.2)	95,489 (32.3)	69,332 (40.9)	26,342 (48.7)
Beta blocker use (N, %)	69,196 (52.3)	139,909 (47.3)	84,336 (49.8)	30,538 (56.4)
Alfa blocker use (N, %)	31,295 (23.7)	69,985 (23.7)	40,961 (24.2)	13,519 (25.0)
Loop diuretic use (N, %)	40,184 (30.4)	66,794 (22.6)	37,845 (22.3)	13,240 (24.5)
Thiazide use (N, %)	24,746 (18.7)	71,574 (24.2)	51,149 (30.2)	19,182 (35.4)
Statin use (N, %)	92,579 (70.0)	204,006 (68.9)	114,241 (67.4)	35,351 (65.3)
eGFR (ml/min/1.73m^2)	49.5±13.4	50.8±14.1	50.7±15.1	49.9±15.1
Cholesterol (mg/dl)	164±38	169±38	173±39	177±42
Albumin (g/dl)	3.9±0.4	4.0±0.4	4.0±0.4	4.0±0.4
Potassium (mEq/l)	4.4±0.5	4.4±0.5	4.4±0.5	4.4±0.5

Results

- 238,640 patients died (mortality rate: 73.5/1000 patient-years, 95% confidence interval [CI]: 73.2-73.8) during a median follow-up of 5.7 years.
- Both SBP and DBP showed a U-shaped association with all-cause mortality.

Kovesdy et al, *Ann Intern Med* 2013;159(4):233-42


Log hazard mortality
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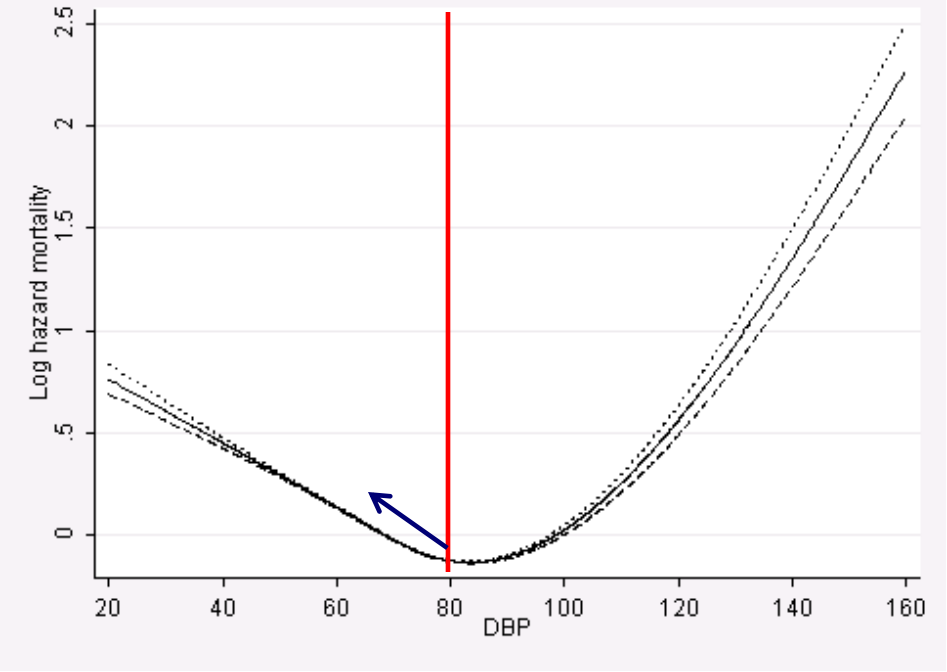
SBP


Log hazard mortality
0
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60
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120
140
160
DBP

		SBP (mmHg)													
		<80	80-89	90-99	100-109	110-119	120-129	130-139	140-149	150-159	160-169	170-179	180-189	190-199	200-210	≥210
DBP (mmHg)	<40	2.56	2.42	2.55	2.15	1.73	1.69	1.91								
	40-49	2.99	2.69	2.31	1.77	1.58	1.39	1.37	1.30	1.50	1.83					
	50-59	3.25	2.88	2.24	1.77	1.51	1.27	1.14	1.17	1.27	1.32	1.63	1.20			
	60-69		3.11	2.32	1.82	1.48	1.23	1.09	1.09	1.12	1.13	1.28	1.36	1.00		
	70-79			2.05	1.70	1.34	1.14	1.01	1.01	1.04	1.07	1.12	1.19	1.11	1.17	1.26
	80-89				1.82	1.27	1.08	0.98	Ref.	1.01	1.07	1.13	1.22	1.43	1.25	1.35
	90-99					1.57	1.26	1.08	1.10	1.15	1.18	1.25	1.23	1.16	1.38	1.04
	100-109							1.53	1.16	1.31	1.33	1.37	1.30	1.62	1.40	1.42
	110-119									1.11	1.28	1.81	1.35	1.89	1.85	1.71
	≥120											1.62			2.44	2.06

Kovesdy et al, *Ann Intern Med* 2013;159(4):233-42

Conclusions

- Both SBP and DBP show J-shaped associations with mortality in veterans with CKD
- Ideal SBP 130-150 mmHg
- Ideal DBP 70-90 mmHg
- DBP lowering below ideal trumped SBP lowering towards ideal

Level of blood pressure control and mortality in US veterans

- Background
  - The ideal BP level in hypertensive patients with CKD is unclear
  - Stricter control is advocated by some, based on the hypothesis that a group with higher CVD risk would benefit from lower BP
  - There are no clinical trials testing this hypothesis

Kovesdy CP et al, JAMA Intern Med 2014

Original Investigation

Observational Modeling of Strict vs Conventional Blood Pressure Control in Patients With Chronic Kidney Disease

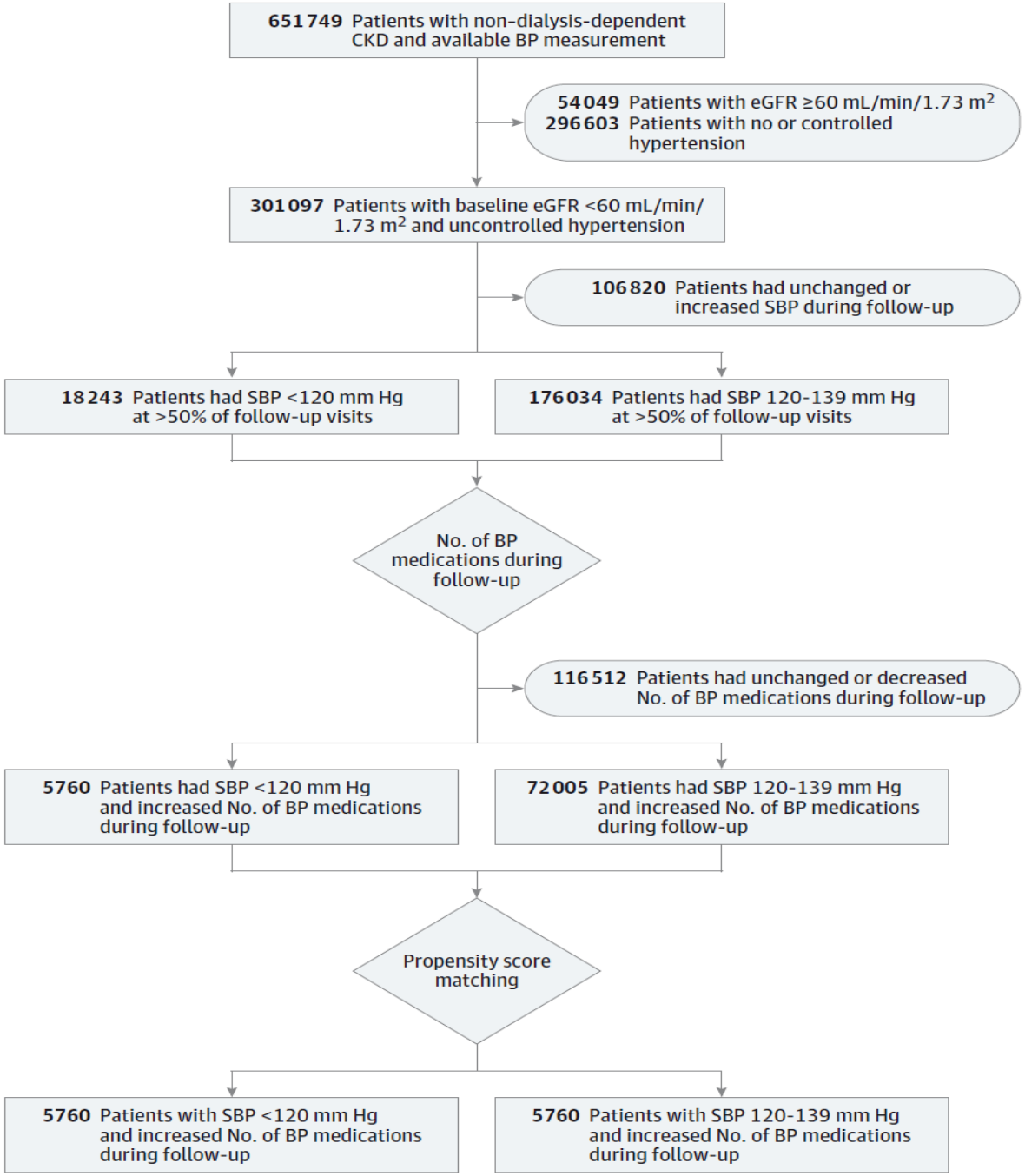
Csaba P. Kovesdy, MD; Jun L. Lu, MD; Miklos Z. Molnar, MD, PhD; Jennie Z. Ma, PhD; Robert B. Canada, MD; Elani Streja, PhD; Kamyar Kalantar-Zadeh, MD, MPH, PhD; Anthony J. Bleyer, MD, MS

JAMA Intern Med. 2014;174(9):1442-1449.

Level of blood pressure control and mortality in US veterans

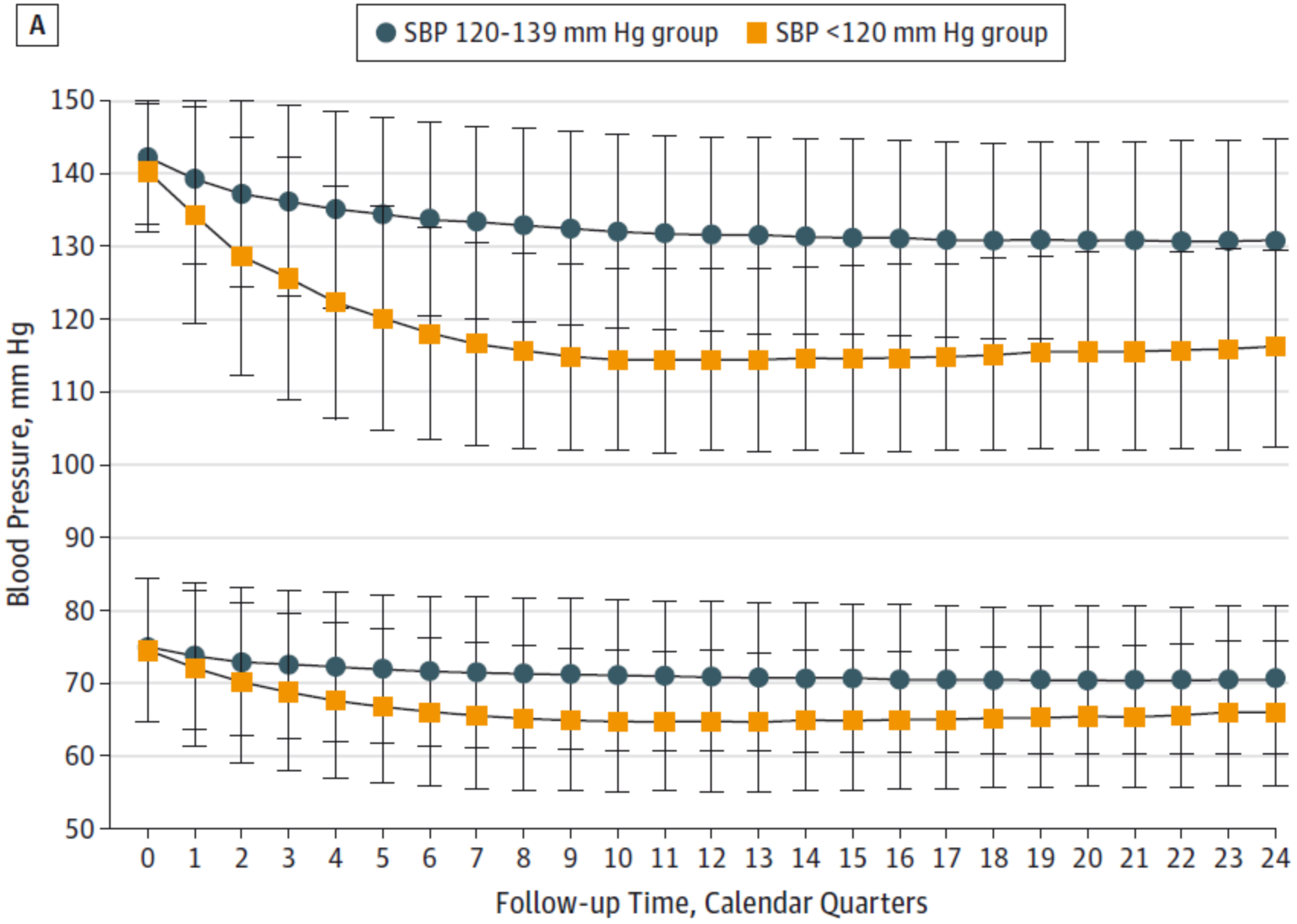
- OBJECTIVE
  - To compare the outcomes associated with a treated systolic blood pressure (SBP) of less than 120 mmHg vs those associated with the currently recommended SBP of less than 140 mmHg in a national CKD database of US veterans.
- DESIGN
  - Observational study in national VA cohort of patients with prevalent CKD and uncontrolled HTN, who subsequently received additional BP medications and experienced a decrease in outpatient SBP

Kovesdy CP et al, JAMA Intern Med 2014



Kovesdy CP et al, JAMA Intern Med 2014

Characteristic	Overall Cohort			Propensity Score–Matched Cohort		
	SBP < 120 mm Hg (n = 5760)	SBP 120-139 mm Hg (n = 72 005)	*P* Value	SBP < 120 mm Hg (n = 5760)	SBP 120-139 mm Hg (n = 5760)	*P* Value
Age, mean (SD)	75.0 (9.2)	73.5 (9.2)	<.001	75.0 (9.2)	75.2 (8.6)	.23
Male sex, No. (%)	5636 (97.9)	70 248 (97.6)	.17	5636 (97.9)	5638 (97.9)	.90
Race, No. (%)						
White	5202 (91.1)	62 234 (88.9)	<.001	5202 (91.1)	5159 (90.2)	.07
Black	363 (6.4)	5876 (8.3)		363 (6.4)	433 (7.6)	
Hispanic	893 (1.3)	57 (1.0)		57 (1.0)	54 (0.9)	
Other	86 (1.5)	1155 (1.6)		86 (1.5)	77 (1.4)	
Cardiovascular disease, No. (%)	2917 (50.6)	27 469 (38.2)	<.001	2917 (50.6)	2929 (50.9)	.82
Diabetes mellitus, No. (%)	2196 (38.1)	28 625 (39.8)	.02	2196 (38.1)	2187 (38.0)	.86
Chronic heart failure, No. (%)	1104 (19.2)	6520 (9.1)	<.001	1104 (19.2)	1117 (19.4)	.76
Cerebrovascular disease, No. (%)	899 (15.6)	9423 (13.1)	<.001	899 (15.6)	903 (15.7)	.92
Charlson comorbidity index, mean (SD)	3.9 (1.7)	3.6 (1.6)	<.001	3.9 (1.7)	3.9 (1.8)	.67
eGFR, mean (SD), mL/min/1.73 m^2	48.1 (9.5)	48.8 (9.1)	<.001	48.1 (9.5)	48.0 (9.5)	.78
Baseline, mean (SD), mm Hg						
SBP	140.8 (8.7)	142.1 (9.0)	<.001	140.8 (8.7)	141.1 (8.5)	.05
DBP	74.4 (9.9)	74.7 (9.8)	.01	74.4 (9.9)	73.3 (9.7)	<.001
Follow-up, mean (SD), mm Hg						
SBP	119.1 (5.5)	133.1 (5.6)	<.001	119.1 (5.5)	132.7 (5.6)	<.001
DBP	66.2 (6.6)	71.1 (7.1)	<.001	66.2 (6.6)	70.1 (7.1)	<.001
BP medications, median (IQR), No.						
At baseline	2 (1-2)	2 (1-2)	.43	2 (1-2)	2 (1-2)	<.001
During follow-up	3 (2-4)	3 (2-4)	<.001	3 (2-4)	3 (2-4)	<.001
Baseline use, No. (%)						
ACEI and/or ARB	2155 (37.4)	27 843 (38.7)	.06	2155 (37.4)	2292 (39.8)	.009
α-Blocker	1068 (18.5)	12 745 (17.7)	.11	1068 (18.5)	1027 (17.7)	.32
β-Blocker	2578 (44.8)	28 775 (40.0)	<.001	2578 (44.8)	2616 (45.4)	.48
Calcium channel blocker	1175 (20.4)	20 333 (28.2)	<.001	1175 (20.4)	1658 (28.8)	<.001
Loop diuretic	1363 (23.7)	10 283 (14.3)	<.001	1363 (23.7)	1174 (20.4)	<.001
Thiazide diuretic	788 (13.7)	15 129 (21.0)	<.001	788 (13.7)	1154 (20.0)	<.001
Serum albumin level, mean (SD), g/dL	3.99 (0.41)	4.02 (0.40)	<.001	3.99 (0.41)	4.02 (0.40)	.04
Serum cholesterol level, mean (SD), mg/dL	168 (38)	172 (38)	<.001	168 (38)	169 (37)	.18



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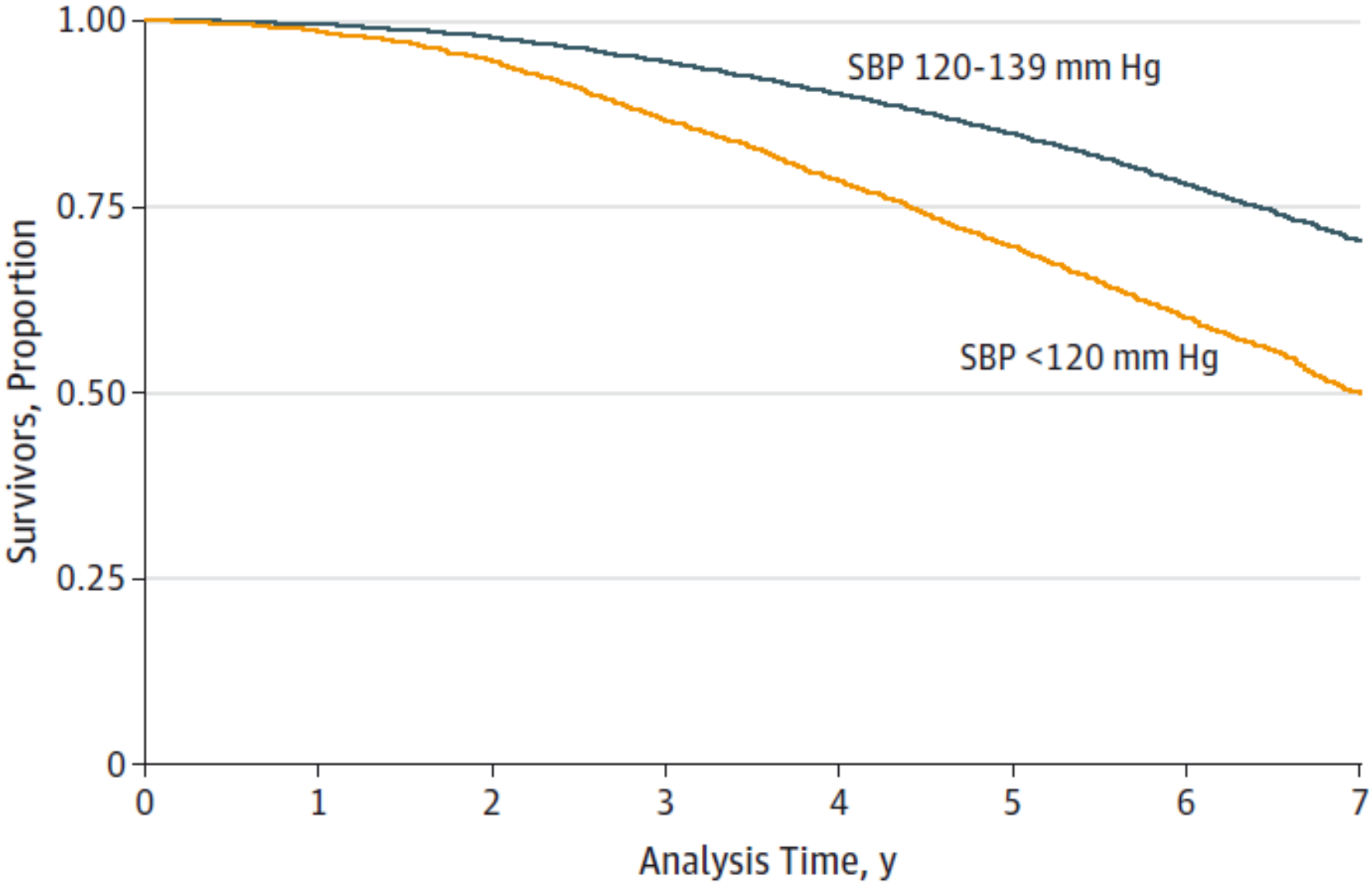

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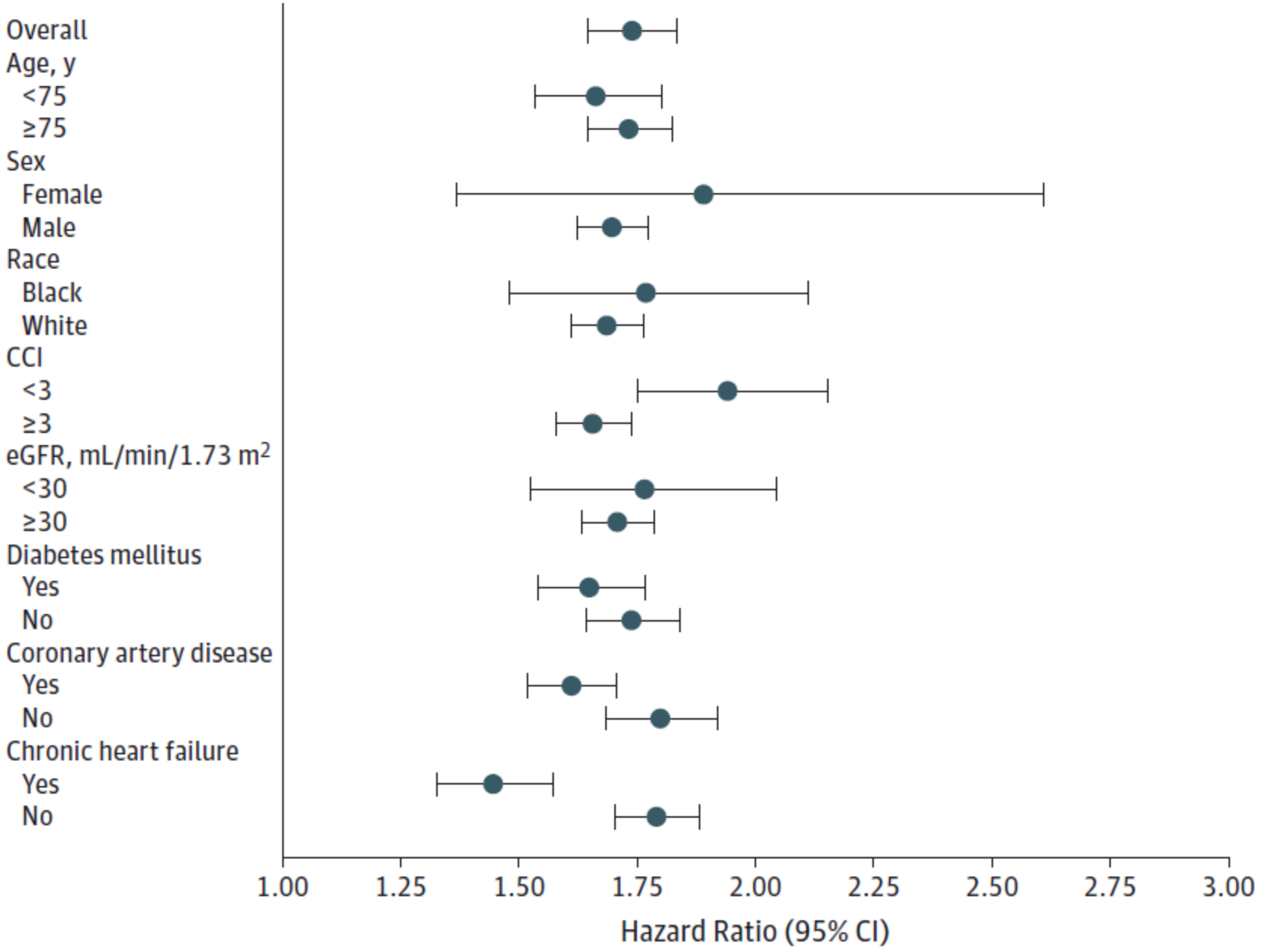


Kovesdy CP et al, JAMA Intern Med 2014

Conclusions

- BP that declined to levels corresponding to strict control was associated with significantly higher mortality compared to BP that declined to levels corresponding to “usual” control
- Hypothesis is being tested in the SPRINT trial

Association of SBP level with outcomes in elderly patients with CKD

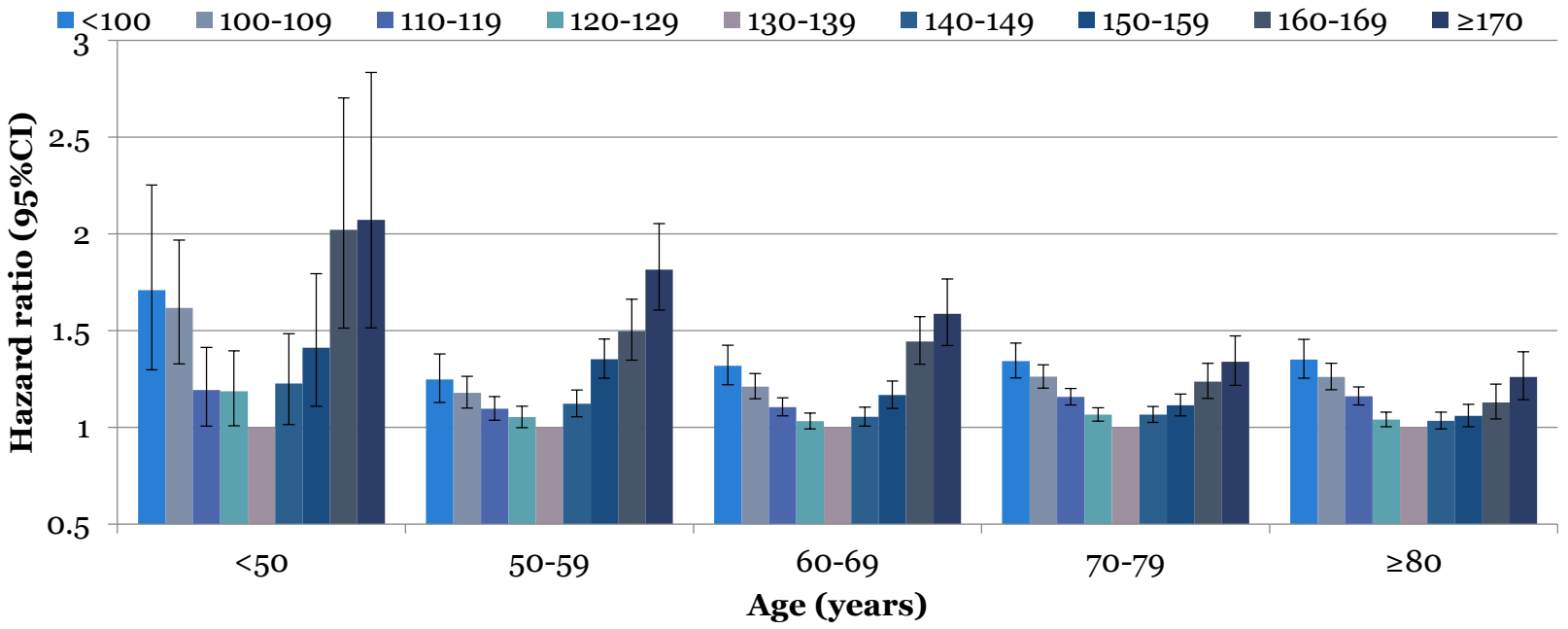
- BACKGROUND
  - CKD affects about 10% of the general population
  - CKD is more common in the elderly
  - CKD is associated with increased mortality and increased risk of CVD
  - It is unclear if age modifies the association of traditional CV risk factors with outcomes in CKD

Association of SBP level with outcomes in elderly patients with CKD

- OBJECTIVE
  - To assess the association between SBP level and mortality, incident CHD, incident stroke and ESRD in non-dialysis dependent CKD patients of different age
- DESIGN AND METHODS
  - Observational study in national VA cohort of 339,887 patients with incident CKD
  - Association between outpatient SBP categories and the different outcomes was examined in subgroups of patients categorized by age, using multivariable adjusted time-dependent Cox models

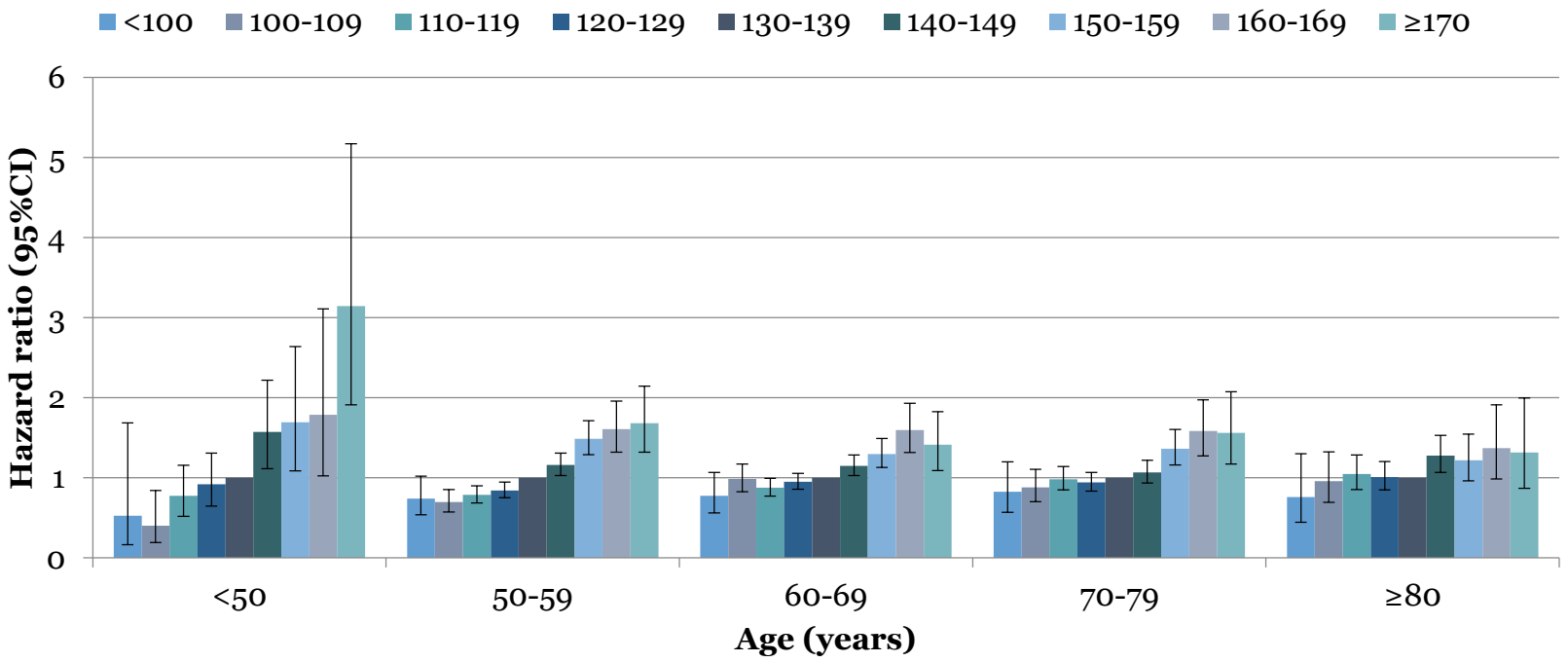
Kovesdy CP et al, submitted

Mortality



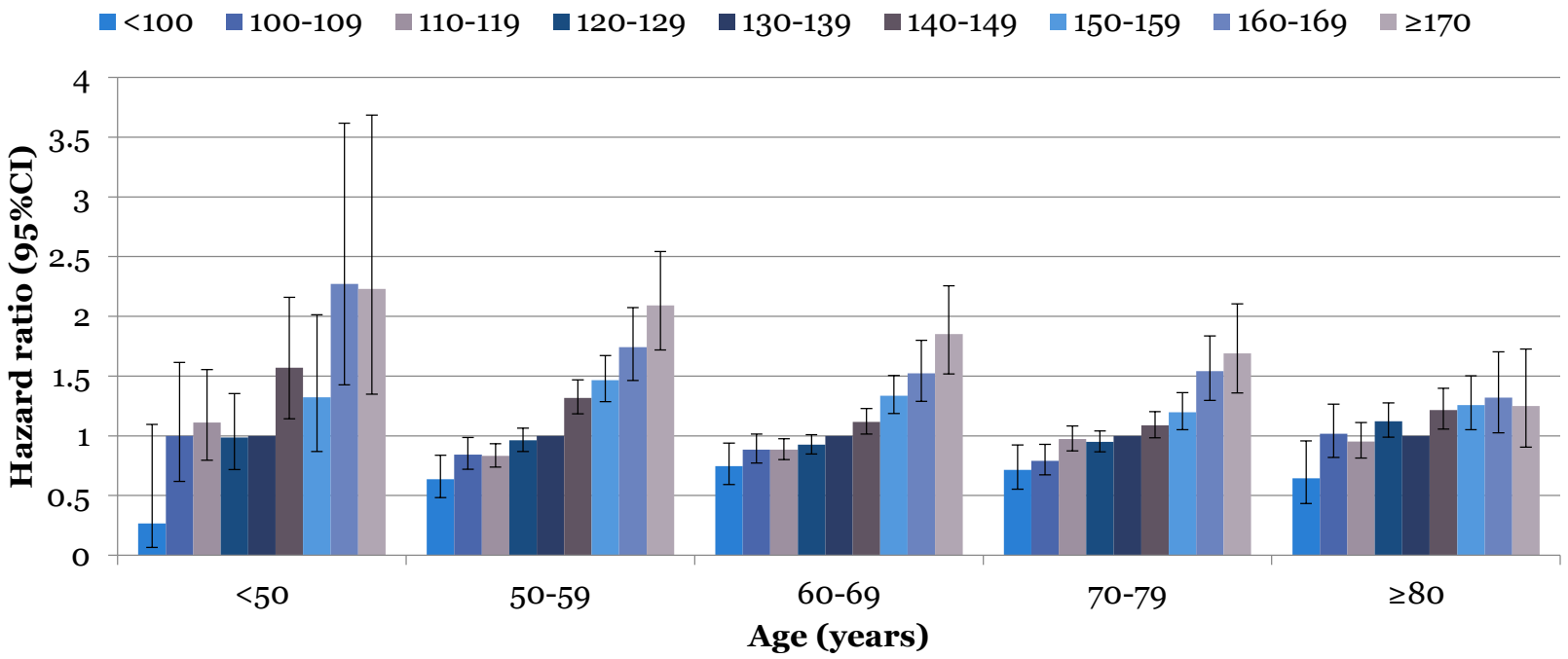
Kovesdy CP et al, submitted

Incident Coronary Heart Disease



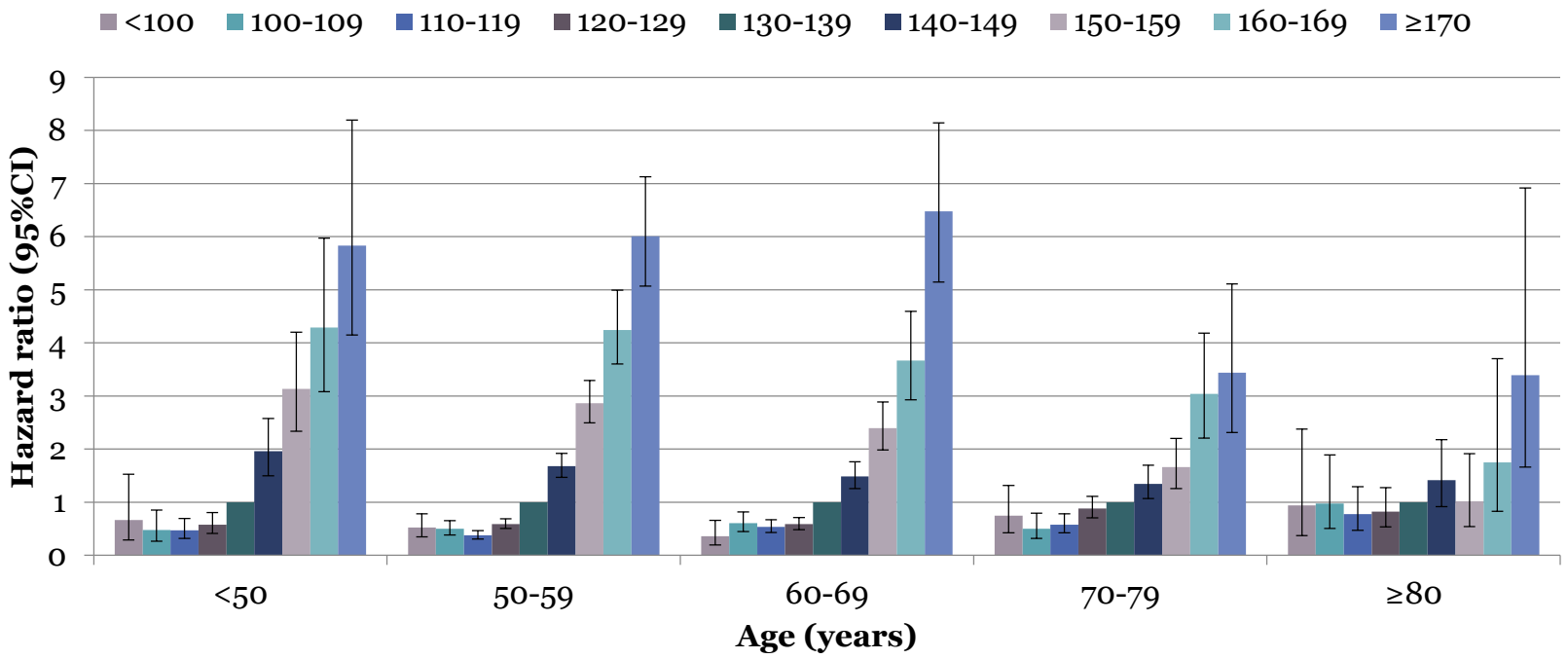
Kovesdy CP et al, submitted

Incident Ischemic Stroke



Kovesdy CP et al, submitted

Incident End Stage Renal Disease



Kovesdy CP et al, submitted

Conclusions

- Age modifies the association between SBP and various outcomes in patients with CKD
  - Low BP associated with higher mortality in all age groups
  - High BP associated with mortality in younger patients, association blunted in the elderly
  - Association of SBP with CHD, stroke and ESRD linear
    - Association with low SBP may be affected by higher mortality
  - Association of high SBP with all outcomes blunted in the elderly and almost absent when age >80 years

Summary

- BP is an important risk factor and treatment target
- BP is measured ubiquitously in veterans
- Combined with the rich clinical data available in the various databases, BP offers a unique opportunity to perform comparative effectiveness research
- Potential for genetic studies (e.g. Million Veteran Program)

Contact Information

Csaba P Kovesdy, MD
Memphis VAMC
1030 Jefferson Ave., Memphis TN 38104
Tel: 901-523 8990
E-Mail: csaba.kovesdy@va.gov