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TITLE: Development of New Point-of-Care Tools to Assess Cardiovascular Disease Risk for Women Within the Primary Healthcare Setting

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14. ABSTRACT The major goal of the first year was to externally validate the VA women CVD risk score with different women population—non-VA women—and recalibrated the VA women CVD risk score to predict ASCVD risk at 10 years in non-VA women as needed. Specific Aim 1: Externally validate and recalibrate the VA women CVD risk score to non-VA and new VA enrollee women. The VA women CVD risk score predicted Atherosclerosis Cardiovascular Disease (ASCVD) event risk at 10 years well for Non-Hispanic (N-H) White, Non-Hispanic (N-H) Black, and Hispanic civilian women and active women military service members with calibration in-the-large. The VA women CVD risk score was calibrated in-the-large with 10-year ASCVD event free survival, S(10), updated from DHS and DaVINCI data, respectively.					
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1. INTRODUCTION: The study externally validated and recalibrated the Veterans Affairs (VA) women cardiovascular disease (CVD) risk score using external data sets on non-VA and VA women different from the original development cohort of the VA women CVD risk score. The external cohorts include 1) women participants in the Dallas Heart Study (DHS) 1 and 2—a 7 year follow-up community population study of Dallas County residents; 2) women in the military from Department of Defense and Veterans Affairs Infrastructure for Clinical Intelligence (DaVINCI) Direct care data; 3) new women veteran enrollees to VA health care between 2018 and 2022; women participants in Dallas Heart Study (DHS)—a 7 year follow-up community population study of Dallas County residents.

2. KEYWORDS:

1. Women veterans;
2. Women in the military;
3. women;
4. veterans affairs;
5. cardiovascular disease risk;
6. point-of-care tool;
7. recalibration;
8. external validation;
9. VA women CVD risk score

3. ACCOMPLISHMENTS:

Overall summary

The study completed its first year, Aim 1 with specific goal 1 (tasks 1,2, 3), and initiated Aim 2 with first Task 1—create a development cohort, listed in Statement of Work (SOW) below Table 1. In summary, the VA women CVD risk score predicted Atherosclerosis Cardiovascular Disease (ASCVD) event risk at 10 years well for Non-Hispanic (N-H) White, Non-Hispanic (N-H) Black, and Hispanic civilian women and active women military service members with just calibration in-the-large. The VA women CVD risk score was calibrated in-the-large with new S(10)s updated from DHS and DaVINCI data, respectively.

The VA women CVD risk score was not well externally validated to predict ASCVD event risk at 5 years for N-H white, N-H black, and Hispanic women veteran who were newly enrolled to VA health care between

2018 and 2022 due to lack of fit. This was due to much shorter follow up period, 5 years, than 10 years and insufficient number of ASCVD events.

What were the major goals of the project?

The major goal of the first year was to externally validate the VA women CVD risk score with different women population—non-VA women—and recalibrated the VA women CVD risk score to predict ASCVD risk at 10 years in non-VA women as needed.

Specific Aim 1: Externally validate and recalibrate the VA women CVD risk score to non-VA and new VA enrollee women.

Goal 1: Recalibrate VA Women CVD risk score using DHS, Women military service members received Direct care from Military health system (DaVINCI), and new VA enrollees

Table 1 summarizes aims and tasks in the statement of work (SOW) and its completion status at 12 months.

Table 1. Statement Of Work (SOW) Aims 1 and 2 (0-12 months)

	Status at 12 months	Data
Specific Aim 1: Externally validate and recalibrate the VA women CVD risk score to non-VA and new VA enrollee women.	Completed	
Recalibrate VA Women CVD risk score using DHS, Women military service members received Direct care from Military health system (DaVINCI), and new VA enrollees	Completed	
Calibration of VA Women CVD risk score using DHS (DHS-1 (baseline) & DHS-2 (7 year follow up)); 3,251 women participants—White women 735, African American women 1,837, Hispanic women 623, and other race 56 at baseline from DHS-1; 1,433 DHS-1 women participants completed a 7 year follow-up (DHS-2) —White women 424, African American women 789, Hispanic women 203, and other race 17.	Completed.	The final DHS sample is 1,400 women (418 White, 766 Black, 199 Hispanic and 17 other race) who has

		completed data for both DHS 1&2 and cause of death data.
Calibration of VA Women CVD risk score using DaVINCI and New VA enrollees since 2018; DaVINCI: 489,858 women active military service members—267,871 Whites, 152,534 African Americans, 62,355 Hispanics, 69,004 Asian Americans or Pacific Islanders, 11,734 Native Americans and Alaska Natives, 23,076 other race, and 98,702 unknown race.	Completed.	Final DaVINCI sample are; Final VA new enrollees are:
Data extraction: Write SQL to extract data from VA CDW; Extract death records VA CDW: 394,650 women veterans who received care at VA health system since January 1, 2007—202,601 Whites, 128,829 African Americans, 29,711 Hispanics, 3,167 Asian Americans and Pacific Islanders, 4,687 American Indians or Alaska Natives, 4,560 Native Hawaiians or Pacific islanders, and 131,621 unknown race.	Completed.	
Data preparation for analysis: transformation, missing data imputation, and coding of predictors	Completed	
Data analysis	Completed	
Recalibration of VA women CVD risk score	Completed	
Estimation Cox regression analysis; model specification, estimation, and performance	Completed	
Create a development cohort		
Data extraction MVP data: 58,970 women veteran participants, 34,310 white women veterans, 16,500 African Americans, 5,500 Hispanic, 2,100 American Indians/Alaskan Natives, 1,179 Asian American, 390 Native	In Progress 40% completed.	Conducted GWAS analysis using MVP data and extracted

<p>Hawaiians/Pacific Islanders, 390 other race, and 660 unknown race.</p>		<p>GWAS data of SNPs associated with ASCVD events, systolic blood pressure, cholesterol, and diabetes. Extracted female sex-specific variables</p>
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What was accomplished under these goals?

1) Major activities: The study extracted, cleaned, imputed, and prepared three external data sets—DHS 1&2, VA Corporate Data Warehouse (CDW) data on women veterans newly enrolled to VA health care system since 2018, and active women service members who received direct care from the military health care system between 2007 and 2022 (DaVINCI)— and external validated and recalibrated the VA women CVD risk score stratified by race groups—N-H white, N-H black, and Hispanic women.

The study team completed the first year and has completed Aim 1 and 40% of the first task of Aim 2 in SOW. The study obtained Dallas Heart Study 1 and 2, extracted data from Veterans Affairs (VA) Corporate Data Warehouse (CDW), obtained death records/cause of death from VA Mortality and Death Records (MDR) National Death Index (NDI), and externally validated and recalibrated the VA women CVD risk score with DHS civilian women, active women service members, and women veterans who enrolled to VA Health care system (new VA enrollees) different from the original development cohort.

The study team prepared three data sets—DHS 1&2, new VA CDW data on new VA enrollees, and DaVINCI—for analysis, transformed, imputed missing data, and created variables of interest. In addition, the study conducted data extraction to create a development cohort to accomplish Aim 2--Develop and internally

validate a new next-generation female sex-specific personalized CVD risk score. In addition, the study conducted Genome Wide Association Study (GWAS) using 58,970 MVP women veteran participants--34,310 White women veterans, 16,500 African Americans, 5,500 Hispanic, 2,100 American Indians/Alaskan Natives, 1,179 Asian American, 390 Native Hawaiians/Pacific Islanders, and 390 other race.

2) Objectives. The objective of the study during the first year was to externally validate and recalibrate the VA women CVD risk score to non-VA and new VA enrollee women using three external data sets—DHS 1&2, women active service members who received direct care from the military health care system between 2007 and 2022 (DaVINCI), and VA CDW data on women veterans newly enrolled to VA health care system since 2018.

3) Results

In summary, the calibrated in-the-large VA women CVD risk score predicted 10-year ASCVD event risk well for Non-Hispanic (N-H) white, N-H black, and Hispanic civilian women with an updated 10 year ASCVD even free survival, $S(10)$.

The VA women CVD risk score was also externally validated for N-H white, N-H black and Hispanic active women military service members. The VA women CVD risk score calibrated in-the-large with a new $S(10)$ from the DaVINCI data predicted ASCVD risk at 10 years for N-H white, N-H black and Hispanic active women military service members.

The study conducted externally validation of the VA women CVD risk score for women veterans newly enrolled to VA health care since 2018. However, VA women CVD risk score lacked in fit for N-H white, N-H black and Hispanic women veteran newly enrolled to VA health care since 2018 due to insufficient number of ASCVD events observed in 5 years. The study attempted to recalibrate and the VA women CVD risk score to fit for newly VA women enrollees a new $S(10)$ extrapolated using parametric survival models, however, extrapolation of $S(10)$ was not useful to recalibration.

Tasks under Aim 1 have been completed. The study obtained DHS and wrote SQL to extract VA CDW data—new VA enrollees—and DaVINCI data. This included vital records from VA Electronic Health Records (EHR) data and cause of death data on 17,445 deceased from VA MDR NDI, which was used to create cardiac deaths.

The VA CDW data were prepared by imputing missing data—Last Observation Move Forward, LOMF—and log transformed continuous variables such as age at visit, systolic blood pressure, total cholesterol, and High Density Lipoprotein Cholesterol (HDL-C). The data were constructed as multiple records per patient and fit for time varying Cox model—time to event model analysis, allowing all CVD risk factors varying by visit (time).

Task 1. Calibration of VA Women CVD risk score using DHS (DHS-1 (baseline) & DHS-2 (7 year follow up))

1. Dallas Heart Study women participants (Civilian women)

The total of 1,433 DHS women participated in both DHS 1 and 2 studies, of these the study excluded 33 with either incomplete CVD events follow up data or previous known CVD events. This yielded a final sample of 1,400 DHS women participants who completed both baseline and 7 year follow up data and no history of CVD events at baseline—Non-Hispanic Whites n=418; Non-Hispanic Blacks n=766; Hispanic n=199; Non-Hispanic Asians n=17. Table 1.1 describes baseline characteristics of DHS women samples.

The mean age of DHS women was 44 year old with a standard deviation of 11 years and N-H white women were oldest followed by N-H black women and Hispanic women were youngest among all race groups at baseline. DHS White women’s total and HDL cholesterol levels and depression rates were significantly higher than other race groups, while Diabetes Mellitus prevalence at baseline was significantly lower. N-H Black women showed significantly higher systolic blood pressure and number on anti-hypertensive medication at baseline than other race groups. Interestingly, DHS N-H black women’s current smoker rate was significantly higher than other groups, in particular, than N-H White women. A significantly higher number of ASCVD events at 10 years was observed among DHS N-H Black women than other race counterparts.

Table 1.1: Dallas Heart Study: Descriptive statistics

	Total (n=1,400)	N-H Whites (n=418)	N-H Blacks (n=766)	Hispanic (n=199)	N-H Asians (n=17)
Age (years)	43.70±10.65	45.90±10.75	43.60±10.47	39.63±9.86	41.92±11.34
Systolic BP	123.58±17.14	119.24±14.00	127.92±17.83	116.84±16.09	114.55±12.02
Diabetes	146 (10.43%)	25 (5.98%)	97 (12.66%)	22 (11.05%)	2 (11.76%)
Current smoker	332 (23.71%)	93 (22.25%)	209 (27.28%)	27 (13.57%)	3 (17.65%)
Mental disorder	178 (13.01%)	76 (18.18%)	86 (11.23%)	16 (8.04%)	0 (0%)

Depression	99 (7.07%)	43 (10.29%)	48 (6.27%)	8 (4.02%)	0 (0%)
Total cholesterol	190.51±37.31	197.05±36.73	187.08±37.41	189.38±35.83	196.0±44.42
HDL	56.07±16.07	58.53±16.71	56.17±16.48	50.96±12.15	50.51±9.37
Treatment of BP	310 (22.14%)	83 (19.85%)	199 (25.98%)	25 (12.56%)	3 (17.65%)
VA women CVD risk score ¹	---	0.1488±0.0905	0.1653±0.1253	0.117±0.0810	0.1458±0.0936
AHA ASCVD risk score ²	---	0.1328±0.0529	0.1333±0.05675	----	0.1051±0.0517
No CVD events/alive	1195 (85.42%)	376 (89.95%)	625 (81.59%)	180 (90.45%)	14 (82.35%)
Non CVD deaths	68 (4.86%)	20 (4.78%)	37 (4.83%)	8 (4.02%)	3 (17.65%)
CVD events (including cardiac deaths)	136 (9.72%)	21 (5.02%)	104 (13.58%)	11 (5.53%)	0 (0%)
Follow-up Month (Length in months)	45.71±16.28	47.51±15.27	46.52±16.01	43.92±16.99	---

Abbreviation. AHA = American Heart Association; ASCVD = Atherosclerosis Cardiovascular Disease; BP = Blood Pressure; CVD = Cardiovascular Disease; VA = Veterans Affairs

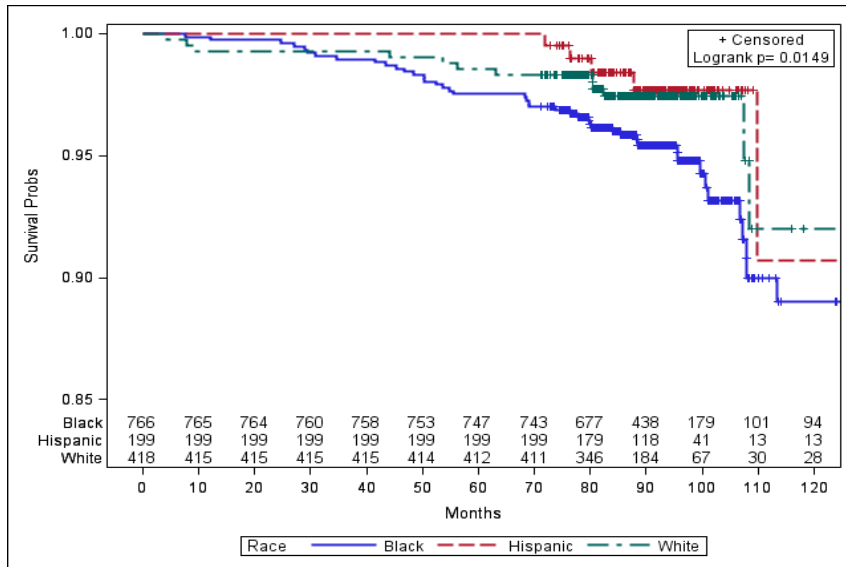
Notes. 1. Jeon-Slaughter H, Chen X, Tsai S, Ramanan B, Ebrahimi R. Developing an Internally Validated Veterans Affairs Women Cardiovascular Disease Risk Score Using Veterans Affairs National Electronic Health Records. *J Am Heart Assoc.* 2021;10(5):e019217. doi:10.1161/JAHA.120.019217

2. Goff DC Jr, Lloyd-Jones DM, Bennett G, et al. 2013 ACC/AHA guideline on the assessment of cardiovascular risk: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines [published correction appears in *Circulation.* 2014 Jun 24;129(25 Suppl 2):S74-5].

Circulation. 2014;129(25 Suppl 2):S49-S73. doi:10.1161/01.cir.0000437741.48606.98

Figure 1.1 showed 10 year CVD event free survival rates among three race group-- Non-Hispanic Whites, non-Hispanic black, and Hispanic women. There is a significant race group difference in a 10-year survival rate with N-H Black with a lowest CVD event free survival.

Figure 1.1. Ten-year CVD event: Kaplan-Meier curves, S(10), by race group--Non-Hispanic Whites, non-Hispanic black, and Hispanic women

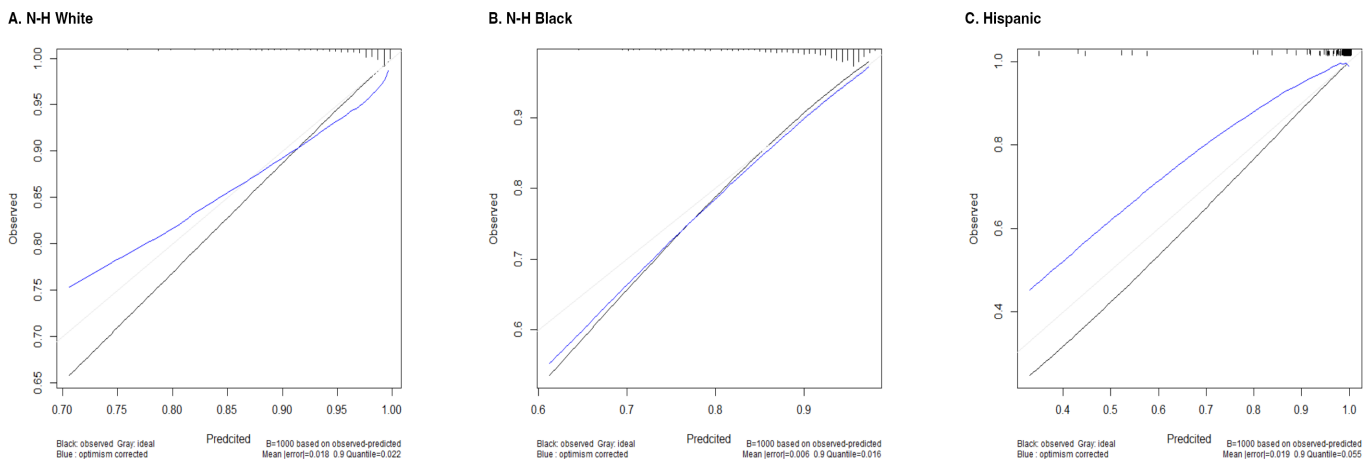


Notes. 1. Log rank test for race group difference in 10-year CVD event rate

2. Censored points are all cause deaths and loss to follow up

The VA women CVD risk score model was calibrated using DHS women and Figure 1.2. showed calibration plots stratified by race.

Figure 1.2. Calibration plots of the VA women risk score model for DHS women by race group



Notes. N-H = Non-Hispanic; Grey line = a 45 degree line; Black lines represent calibration plots between original predicted and observed 10-year ASCVD risk; Blue lines represent bias corrected calibration plots correction of overfitting.

The calibration plots indicated that the VA women CVD risk score model fitted well to predict DHS N-H White, N-H Black, Hispanic women’s 10-year ASCVD risk with slight overestimation. The model of the VA women CVD risk score was accepted but calibration in-the-large and recalibration may required to improve a model fi to the external data set, DHS.

Task 2. Calibration of VA Women CVD risk score using DaVINCI and New VA enrollees since 2018;

DaVINCI: 489,858 women active military service members--267,871 Whites, 152,534 African Americans, 62,355 Hispanics, and 69,004 Asian Americans or Pacific Islanders, 11,734 Native Americans and Alaska Natives, 23,076 other race and 98,702 unknown race.

2.A. DaVINCI

Of all 526,827 active military women service members who received Direct Care from Military health care system between January 01, 2007 and December 31, 2022, we excluded those with incomplete data on demographics and included only those with a minimum two consecutive visit records with complete systolic blood pressure (SBP) at each visit. The final sample size of DaVINCI samples is 107,613 active women military service members. Of these, N-H White women are 47,283 (44%), N-H Black women n= 29,646 (28%), Hispanic women n=12,417 (12%), and other race women n=18,627 (17%). The mean age of all DaVINCI women was 33.1 years old with standard deviation of 11.5 years old. Significantly higher rates of current smoking and depression at baseline were observed among N-H white active women military service members compared to other race group counterparts. N-H Black active women service members had significantly higher 10-year ASCVD incidence than their N-H white and Hispanic counterparts.

Table 2.A.1. DaVINCI 2007-2022: Baseline CVD Risk Factors Stratified by Race group (n=107,613)

	Total N=107,613 (100%)	White, n=47,283 (44%)	Black, n= 29,646 (28%)	Hispanic, n=12,417 (12%)	Other n=18,627 (17%)
Age, mean ± SD, y	33.14 ± 11.50	33.73 ±	35.55 ±	29.27 ±	35.15 ± 12.98

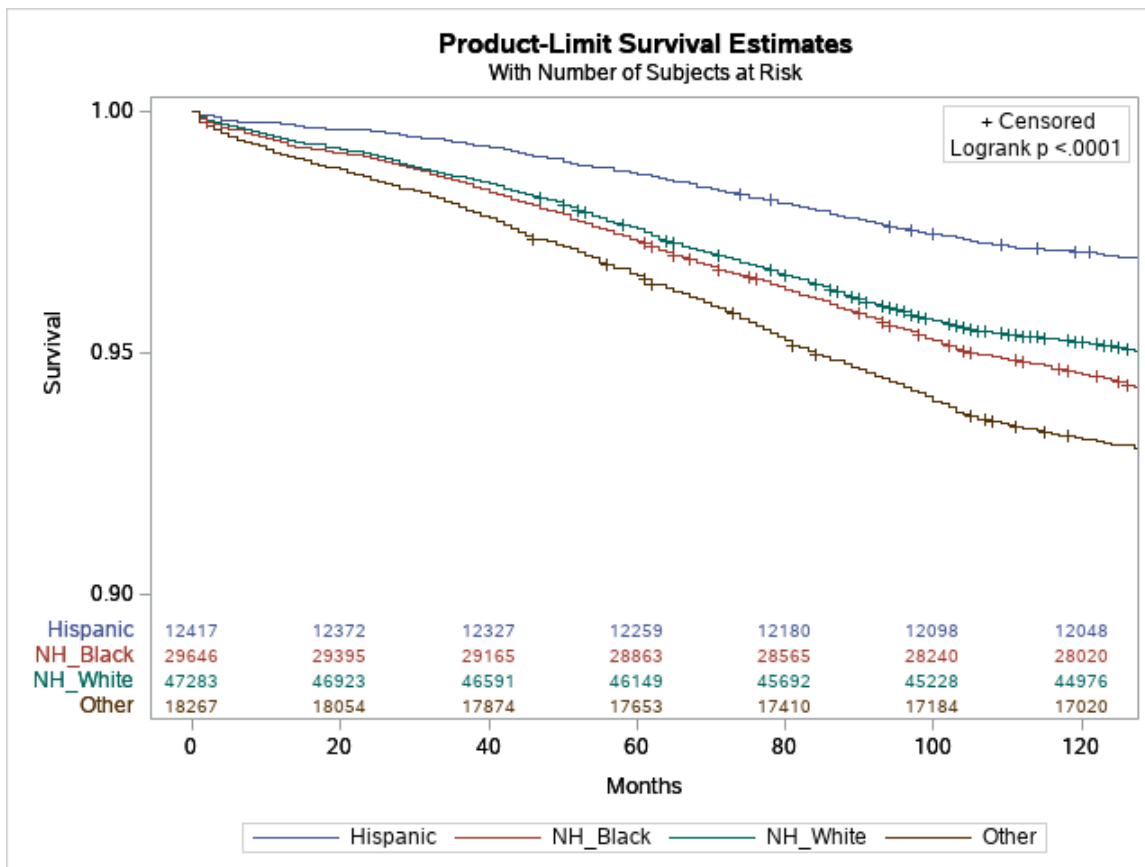
		11.42	10.61	8.94	
SBP, mean \pm SD, mm Hg	120.36 \pm 12.94	119.72 \pm 12.17	122.48 \pm 13.59	116.69 \pm 11.35	121.08 \pm 14.05
Diabetes mellitus, n (%)	2,974 (2.8%)	931 (2.0%)	997 (3.4%)	176 (1.4%)	870 (4.7%)
Current smoking, n (%)	3,005 (1.9%)	1,702 (3.6%)	518 (1.7%)	230 (1.9%)	555 (3.0%)
Major depression, n (%)	3,493 (3.2%)	1,862 (4.0%)	659 (2.2%)	322 (2.6%)	650 (3.5%)
Total cholesterol, mean \pm SD, mg/dL	196.09 \pm 37.28	196.61 \pm 37.53	196.19 \pm 36.94	191.15 \pm 36.39	197.96 \pm 37.47
HDL-C, mean \pm SD, mg/dL	52.49 \pm 11.34	52.18 \pm 11.43	53.57 \pm 11.24	51.14 \pm 10.87	52.48 \pm 11.45
Follow-Up Month (Length in Months)	135.55 \pm 49.47	131.67 \pm 50.06	143.35 \pm 47.97	125.62 \pm 50.58	139.69 \pm 47.25
ASCVD events, incidence per 1000 person-year (%)	11,227 (10.4%, 6.52)	4,219 (8.9%, 5.58)	3,641 (12.3%, 7.68)	672 (5.4%, 3.38)	2,695 (14.8%, 9.22)
Nonfatal myocardial infarction	3,994 (3.7%, 2.32)	1,562 (3.3%, 2.06)	1,200 (4.0%, 2.53)	283 (2.3%, 1.42)	949 (5.2%, 3.25)
Nonfatal stroke	4,276 (4.0%, 2.48)	1,660 (3.5%, 2.19)	1,401 (4.7%, 2.95)	252 (2.0%, 1.27)	963 (5.3%, 3.29)
Cardiac death	60 (0.1%, 0.03)	20 (0.0%, 0.03)	21 (0.1%, 0.04)	1 (0.0%, 0.01)	18 (0.1%, 0.06)
Heart failure	2,582 (2.4%, 1.50)	867 (1.8%, 1.15)	909 (3.1%, 1.92)	116 (0.9%, 0.58)	690 (3.8%, 2.36)
Cardiac arrest	315 (0.3%, 0.18)	110 (0.2%, 0.15)	110 (0.4%, 0.23)	20 (0.2%, 0.10)	75 (0.4%, 0.26)
Death	553 (0.5%, 0.32)	240 (0.5%, 0.32)	179 (0.6%, 0.38)	38 (0.3%, 0.19)	96 (0.5%, 0.33)

Abbreviation. AHA = American Heart Association; ASCVD = Atherosclerosis Cardiovascular Disease; BP = Blood Pressure; CVD = Cardiovascular Disease; VA = Veterans Affairs

Notes. 1. Jeon-Slaughter H, Chen X, Tsai S, Ramanan B, Ebrahimi R. Developing an Internally Validated Veterans Affairs Women Cardiovascular Disease Risk Score Using Veterans Affairs National Electronic Health Records. J Am Heart Assoc. 2021;10(5):e019217. doi:10.1161/JAHA.120.019217

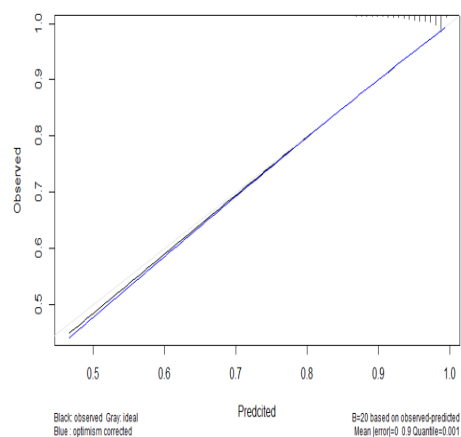
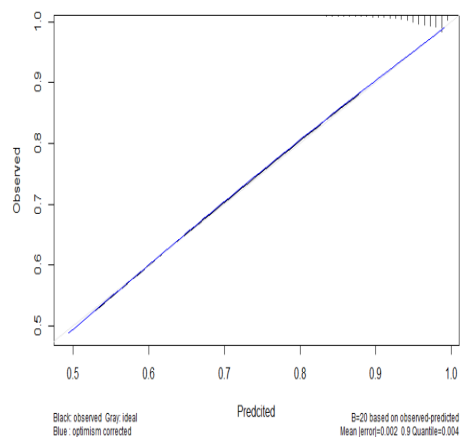
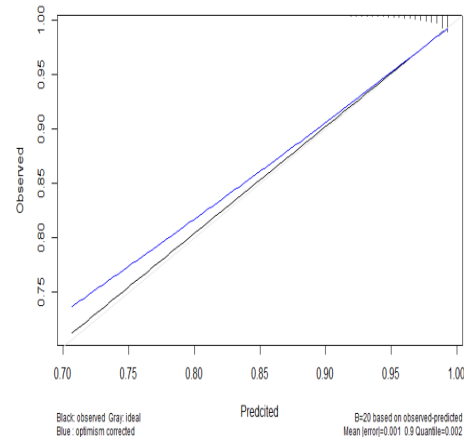
There was a significant race group difference in a 10-year ASCVD event free survival rate, $S(10)$, estimated by K-M curves. N-H white and N-H Black active duty women service members' $S(10)$ s were similar but their $S(10)$ s were significantly lower than their Hispanic counterparts.

Figure 2.A.1. Kaplan Meier curves, $S(10)$, by race group: DaVINCI



Notes. 1. Log rank test for race group difference in 10-year CVD event rate
2. Censored points are all cause death or loss to follow up

Figure 2.A.2. Calibration plots by race group (DaVINCI)

A. N-H White**B. N-H Black****C. Hispanic**

Notes. N-H = Non-Hispanic; Grey line = a 45 degree line; Black lines represent calibration plots between original predicted and observed 10-year ASCVD risk; Blue lines represent bias corrected calibration plots correction of overfitting.

Observed calibration plots indicate the VA women CVD risk score model predicts a 10-year ASCVD risk well for both N-H White and Black women active service members, while slightly under estimating a 10-year ASCVD risk of Hispanic women service members. DaVINCI samples were about 10 years younger at baseline compared to the development cohort of the VA women CVD risk score (mean ages 45, 44, and 43 for N-H white, N-H black, and Hispanic women, respectively). Major depression prevalence was significantly lower among DaVINCI samples than the original development cohort of the VA women CVD risk score.

2.B. New VA women enrollees between 2018 and 2022.

Of all 13,456 new VA women enrollees between January 01, 2018 and December 31, 2022, we excluded those with incomplete data on demographics—birth date and race—and included those with a minimum two consecutive visit records with complete systolic blood pressure data at each visit. The final sample size of the new VA enrollee samples is 6,763 women veterans. Of these, N-H White women are 3,140 (46%), N-H Black women 1,879 (28%), Hispanic women 859 (13%), and other race 885 (13%).

Table 2.B.1. Baseline Risk Factors stratified by race group (Total N=6,763)

	Total n=6,763 (100%)	White, n=3,140 (46.43%)	Black n=1,879 (27.78%)	Hispanic n=859 (12.70%)	Other n=885 (13.09%)
Age in 2018 (mean±SD)	38.16±12.38	38.99±12.99	38.20±11.66	33.94±10.50	39.24±12.47
SBP (mean±SD)	120.63±13.90	120.81±13.75	121.91±14.43	117.41±12.45	120.41±14.10
Diabetes mellitus	150 (2.22%)	57 (1.82%)	54 (2.87%)	4 (0.47%)	35 (3.95%)
Current smoking	642 (9.49%)	372 (11.85%)	141 (7.50%)	55 (6.40%)	74 (8.36%)
Major depression	1281 (18.94%)	606 (19.30%)	344 (18.31%)	172 (20.02%)	159 (17.97%)
Anti-hypertensive Treatment	508 (7.51%)	220 (7.01%)	163 (8.67%)	53 (6.17%)	72 (8.14%)
Total cholesterol (mean±SD)	197.09±38.30	199.69±38.55	194.33±37.35	190.73±36.88	199.87±39.64
HDL-C (mean±SD)	51.76±11.20	51.73±11.45	52.60±11.01	50.26±10.31	51.50±11.45
Follow-up Month (Length in months)	46.19±16.04	45.88±16.22	47.59±15.22	46.54±15.91	44.01±16.97
All cause death	43 (0.64%)	25 (0.79%)	7 (0.37%)	3 (0.35%)	8 (0.89%)
ASCVD (1000 person-year, %)	20 (0.59, 0.30%)	13	4	2	1
Nonfatal myocardial infarction	5 (0.07%)	4 (0.13%)	1 (0.05%)	0 (0.00%)	0 (0.00%)
Stroke	4 (0.06%)	2 (0.06%)	0 (0.00%)	1 (0.12%)	1 (.11%)
Cardiac death	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
Heart failure	11 (0.26%)	7 (0.22%)	3 (0.16%)	1 (0.12%)	0 (0.00%)
Cardiac arrest	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)

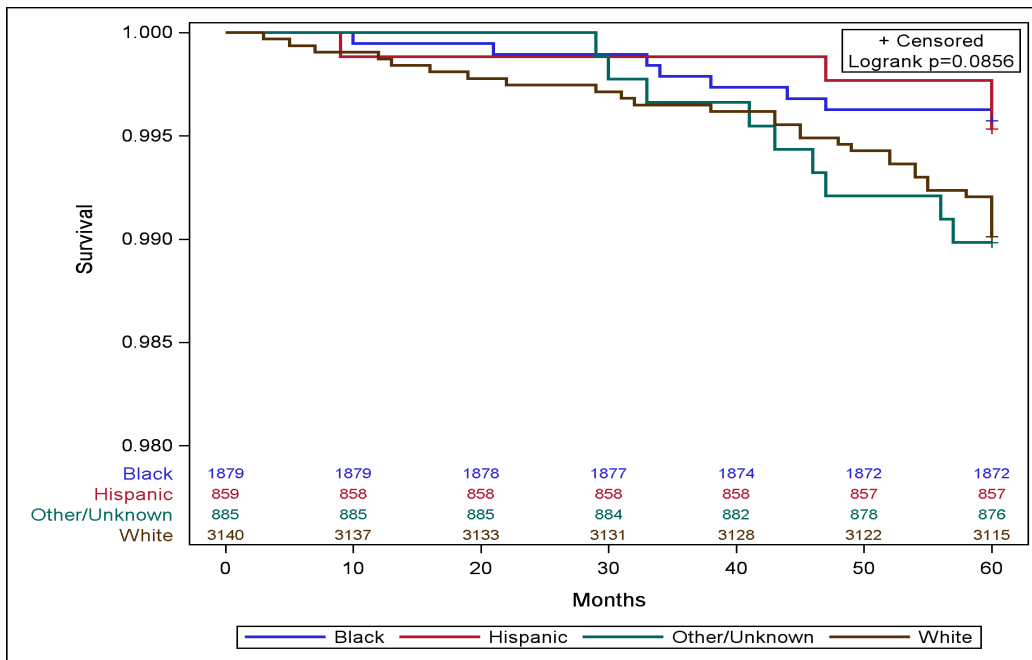
Abbreviation. AHA = American Heart Association; ASCVD = Atherosclerosis Cardiovascular Disease; BP = Blood Pressure; CVD = Cardiovascular Disease; VA = Veterans Affairs

Notes. 1. Jeon-Slaughter H, Chen X, Tsai S, Ramanan B, Ebrahimi R. Developing an Internally Validated Veterans Affairs Women Cardiovascular Disease Risk Score Using Veterans Affairs National Electronic Health Records. J Am Heart Assoc. 2021;10(5):e019217. doi:10.1161/JAHA.120.019217

The new VA enrollee's data had a maximum follow-up length for 5 years at the time of the study. The 5-year ASCVD event free survival rate, $S(5)$, was estimated by K-M curves, similar among race groups. $S(5)$ s were estimated as 0.9901, 0.9957, 0.9953, and 0.9898 for N-H white, N-H Black, Hispanic, and other race women, respectively.

Figure 2.B.1 showed Kaplan-Meier curves stratified by race group. There was no significant race group difference in 5-year ASCVD event free survival.

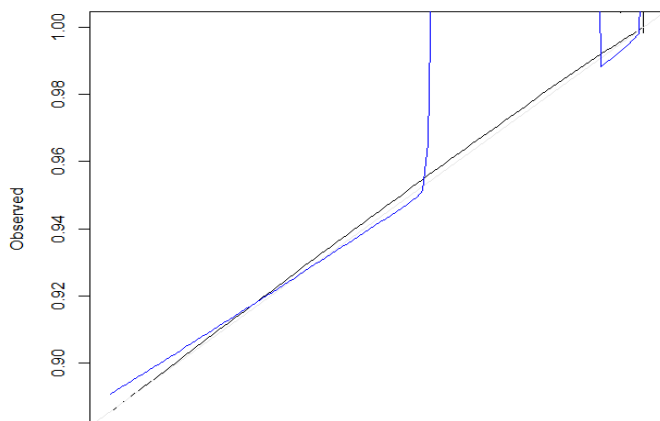
Figure 2.B.1. Kaplan-Meier curves, $S(5)$, by race group (VA new enrollees)



Notes. 1. Log rank test for race group difference in 10-year CVD event rate

2. Censored points are all cause death or loss to follow up

Figure 3.B.2. Calibration plots for new VA new enrollee N-H white women



Notes. N-H = Non-Hispanic

1. Calibration plots for N-H black and Hispanic women are missing due to failure of convergence and lack of sufficient ASCVD events within the 5-year follow up.

Calibration plots indicate a poor fit of the VA women CVD risk score model to data on new VA women enrollees between 2018 and 2022. New VA women enrollee samples were about 5-7 years younger at baseline compared to the original VA women cohort (mean ages 45, 44, and 43 for N-H white, N-H black, and Hispanic women, respectively). Diabetes rates were significantly lower among new VA enrollee samples than the original development cohort of the VA women CVD risk score. The most striking difference in new VA women enrollee data from the original VA women CVD risk score development cohort is number of ASCVD events observed. The new VA women enrollee data had a shorter follow up period, 5 years, than 10 years, thus number of ASCVD events was significantly smaller than the development cohort of the VA women CVD risk score.

3. External validation and recalibration

Three data sets, DHS, new VA enrollees, and DaVINCI, were used to externally validate the VA women CVD risk score. The VA women CVD risks score was tested for fit of goodness for non-VA women by Hosmer-Lemeshow (H-L) and likelihood ratios. The study further externally validated the VA women CVD risk score by calibration in-the-large and recalibration using three external data sets—DHS 1&2, VA CDW on new VA women enrollees, and DaVINCI.

3.1. Data sets

3.A. Dallas Heart Study (DHS)

The original VA women CVD risk score was externally validated with DHS women participants, VA new enrollees between 2018 and 2022, and DaVINCI between 2007 and 2022. The calibration plots and Hosmer-Lemeshow tests were used to check a model fit of the VA women CVD risk score to three external data sets. When recalibration of the VA women CVD risk score is needed for the new data sets, we started with calibration in-the-large by updating with a new $S(10)$ from each data set. And then we conducted recalibration with updated $S(10)$ from the data sets via K-M curves and estimated multiplicative factor, α^* , by running a cox

regression on a linear predictor of the VA women CVD risk score. The recalibrated VA women CVD risk score is $S(10)^* \exp [\alpha^*(x\beta)]$, where $S(10)^*$ is updated $S(10)$, α^* is a coefficient, and β are original VA women risk score coefficients of all risk factors, X , included in the VA women risk score. The likelihood ratio and Hosmer-Lemeshow tests and calibration intercepts and slopes (perfect fit intercept 0 and slope =1) were used to guide needs for calibration in-the-large and recalibration.

Table 3.A.1. Hosmer-Lemeshow (H-L) tests of the original VA women CVD risk score (no update with UTSW data)

decile	N-H Whites (n=418)		N-H Blacks (n=766)		Hispanic (n=199)	
	observed	predicted	observed	predicted	observed	predicted
1	0.00	0.01655	0.0658	0.0184	0.0000	0.01399
2	0.00	0.02673	0.0533	0.02985	0.1000	0.021
3	0.02439	0.03658	0.0395	0.03784	0.000	0.025779
4	0.000	0.0482	0.05333	0.04568	0.00	0.03123
5	0.02439	0.0596	0.10526	0.05515	0.05	0.03752
6	0.07143	0.071899	0.17333	0.0651	0.05263	0.04595
7	0.02439	0.085658	0.09333	0.0802	0.00	0.05604
8	0.04761	0.1028	0.18421	0.102785	0.05263	0.066694
9	0.09756	0.12957	0.16	0.1358	0.15	0.089176
10	0.2381	0.20574	0.4342	0.2215	0.15	0.1394
H-L stats (p value)	0.2028 (p=0.9999)		0.7775 (p=0.9993)		0.9689611 (p=0.9984)	

Abbreviations. H-L = Homer-Lemeshow;

3.A.2. Calibration plots

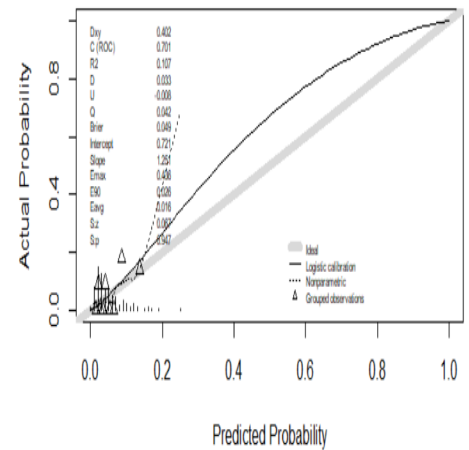
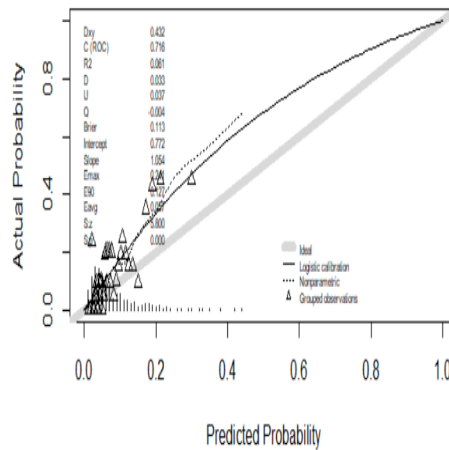
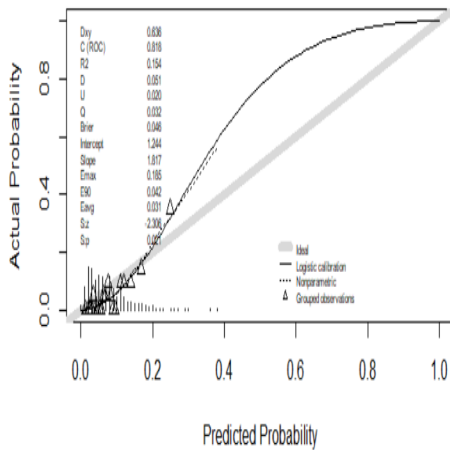
Figure 3.A.1 showed calibration plots of the original VA women CVD risk scores for DHS N-H white, N-H black, and Hispanic civilian women.

Figure 3.A.1. Calibration plots of the VA women CVD risk scores by race group

A. N-H White

B. N-H Black

C. Hispanic



Notes. N-H= Non-Hispanic

1. External validation of the VA women CVD risk score by race group
2. Calibration intercepts and slopes for N-H white women are 1.244 and 1.817, 0.772 and 1.054 for N-H Black women and 0.721 and 1.251 for Hispanic women.

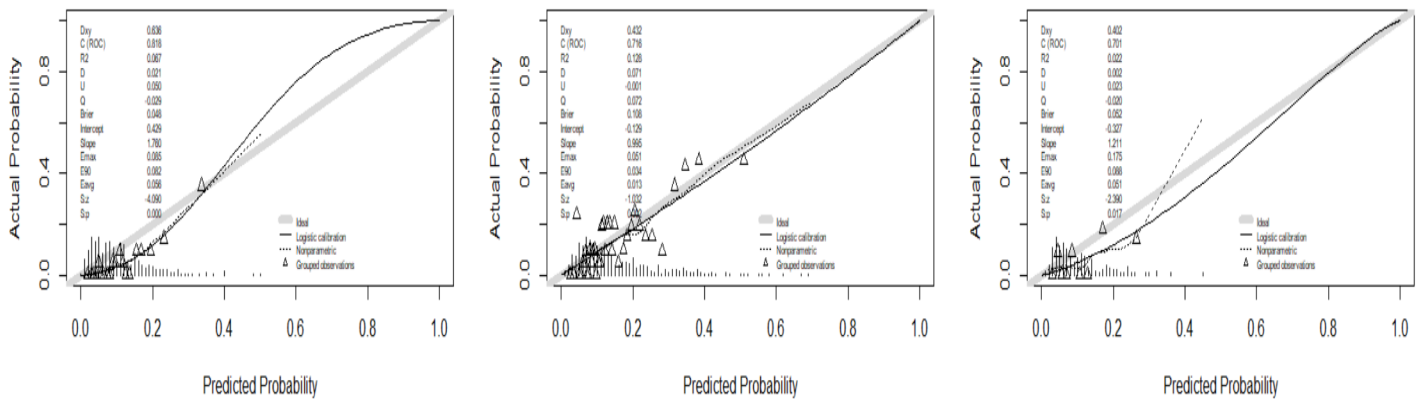
3.A.3. Calibration-in-the-large: The study updated S(10) and the means of risk factors with the DHS data sets to the VA women CVD risk score stratified by race/ethnicity group.

Figure 3.A.2 Calibration plots of calibration in the large VA women CVD risk score to civilian women (DHS) by race group

A. N-H White

B. N-H Black

C. Hispanic



Notes. N-H= Non-Hispanic

1. Validation of the calibration in-the-large VA women CVD risk score with an updated S(10)
2. Calibration intercepts and slopes for N-H white women are 0.429 and 1.760, -0.129 and 0.995 for N-H Black women and -0.327 and 1.211 for Hispanic women.

3.A.4. Recalibration: The study updated VA women CVD risk score with S(10), means of risk factors, and a coefficient (α^*) for the recalibration model $S(10)^* \exp [\alpha^*(x\beta)]$ with the DHS data sets to the VA women CVD risk score stratified by race/ethnicity group.

The study conducted Hosmer-Lemeshow (H-L) test of original VA women CVD risk score and the VA women CVD risk score updated with new S(10), mean risk factors using DHS data set, and multiplication of a coefficient (α^*).

Stratified by race/ethnicity group, likelihood ratio (LR) tests were conducted to compare a model fit of the VA women CVD risk score with calibration in-the-large and recalibration (Table 3.A.2).

Table 3.A.2. Recalibrated VA women CVD risk score with new S(10) and coefficient alpha from DHS per race group

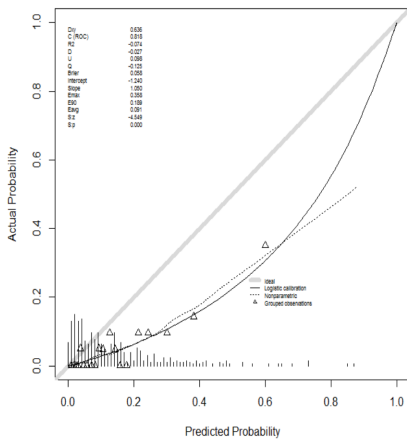
			Significantly different between models		Calibration plot	
	S(10)	alpha	Log-Likelihood ratio test	Hosmer-Lemeshow	Intercept	Slope

White	0.92	1.521	No	3.358 (p=0.9099)	-1.24	1.05
Black	0.89	0.665	Yes	1.392 (p=0.9943)	0.767	1.522
Hispanic	0.907	0.728	yes	1.692 (p=0.9891)	0.735	1.674

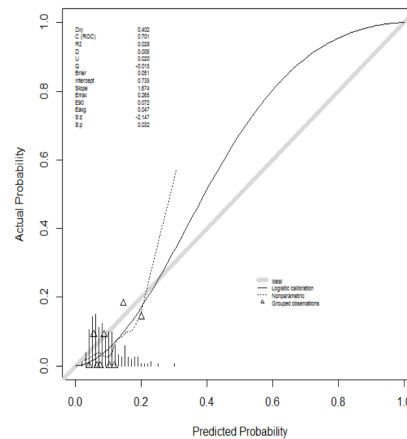
Notes

Figure 3.A.3 Calibration plots of the recalibrated VA women CVD risk score to civilian women (DHS) by race group

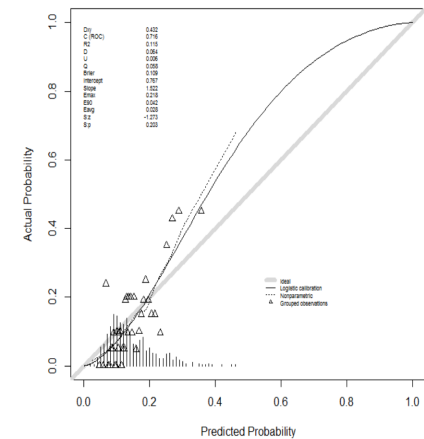
A. N-H White



B. N-H Black



C. Hispanic



Notes. N-H= Non-Hispanic

1. Validation of the recalibrated VA women CVD risk score with an updated S(10) and alpha coefficients

The original VA women CVD risk score fits well for N-H white civilian women based on DHS data set. The VA women CVD risk score calibrated in the large with new S(10) from DHS data fitted best for all three race groups, N-H White, N-H Black and Hispanic civilian women. When compared calibration in-the-large to recalibrated VA women CVD risk score, there was no difference found in N-H white women, while there was significant difference among DHS N-H Black and Hispanic civilian women. Recalibrated VA women CVD risk score fits well with updated S(10) and new alpha, a multiplication factor (Table 3.A.2) for N-H Black and Hispanic civilian women. The recalibrated VA women CVD risk scores are with S(10) of 0.89 and 0.907 and $x\beta$ multiplied by alpha coefficient, α^* , of 0.665 and 0.7275, for N-H black and Hispanic civilian women, respectively.

Overall, the calibration in-the-large VA women CVD risk score fits well to predict a 10-year ASCVD risk for N-H white, N-H Black, and Hispanic civilian women.

3.B. VA new enrollees

The VA CDW data on women veterans who newly enrolled and received care from VA health care system between January 1, 2018 and Dec 31, 2022 were used to externally validate the VA women CVD risk score.

First, H-L test and calibration plots of intercepts and slopes were used to assess the need for recalibration of the VA women CVD risk score to new VA enrollees between 2018 and 2022.

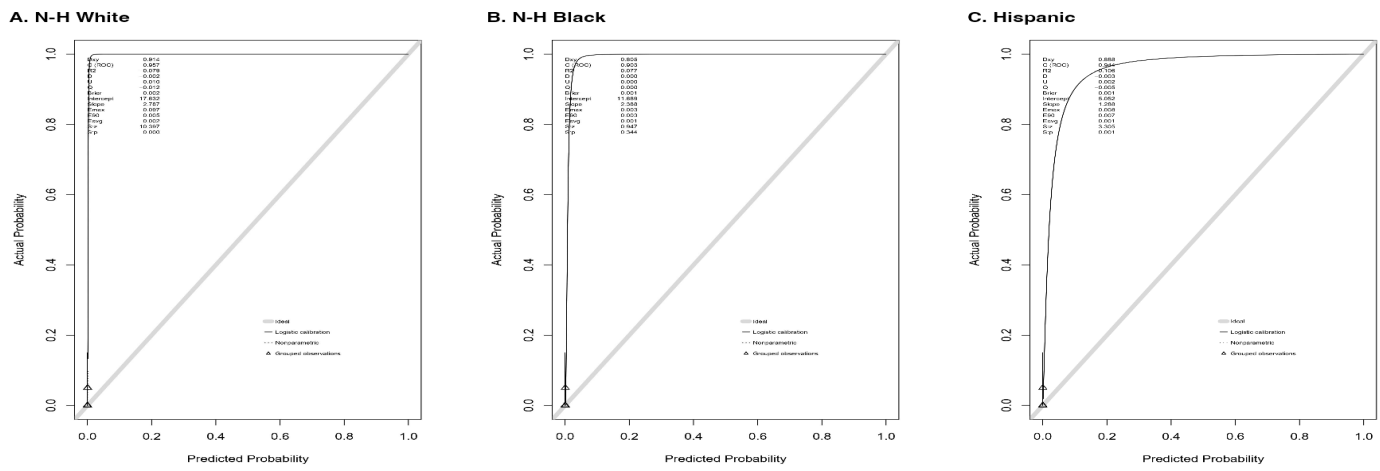
Table 3.B.1. Hosmer-Lemeshow (H-L) tests of the original VA CVD score (no update with VA women veteran newly enrollees data)

	White, n=3,140 (46.43%)		Black n=1,879 (27.78%)		Hispanic n=859 (12.70%)	
Decile (g)	observed	predicted	observed	predicted	observed	predicted
1	0.00	0.0000085	0.00	0.000031	0.00	0.0000027
2	0.00	0.000017	0.00	0.000056	0.00	0.0000045
3	0.00	0.0000295	0.00	0.000091	0.00	0.0000064
4	0.00	0.000051	0.00	0.000146	0.00	0.0000093
5	0.00	0.000081	0.00	0.000208	0.00	0.0000135
6	0.00	0.000121	0.00	0.000284	0.00	0.0000195
7	0.0001	0.000184	0.00	0.000397	0.00	0.0000298
8	0.0017	0.000375	0.0016	0.000720	0.00037	0.0000647
H-L stats (p value)	0.005(p=1.00)		0.0054 (p=1.00)		0.00147 (p=1.00)	

Notes. H-L = Homer-Lemeshow

3.B.1. Calibration plots by race group

Figure 3.B.1. External validation of the VA women CVD risk score

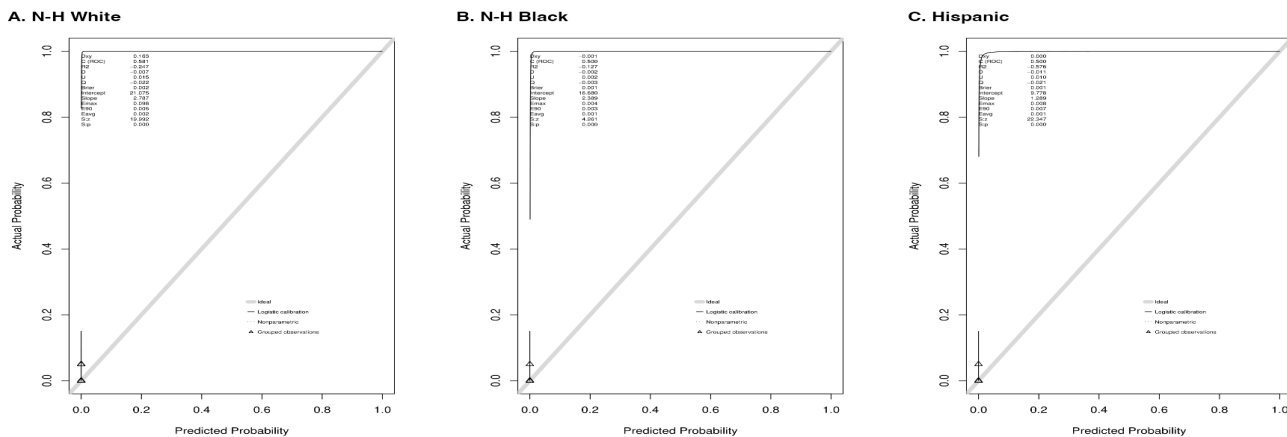


Notes. N-H= Non-Hispanic

1. Validation of the calibration in-the-large VA women CVD risk score with an updated S(5)
2. Calibration intercepts and slopes for N-H white women are 17.632 and 2.787, 11.689 and 2.389 for N-H Black women and 5.052 and 1.289 for Hispanic women.

3.B.2 Calibration in-the-large: The study estimated new S(5) using new VA enrollee data set stratified by race/ethnicity group via Kaplan-Meier (K-M) curves. The study updated the VA women CVD risk score with a new S(5) and the means of risk factors with the VA women veteran newly enrollee data to the VA women CVD risk score stratified by race/ethnicity group.

Figure 3.B.2. External validation of calibration in-the-large of the VA women CVD risk scores by race



Notes. N-H= Non-Hispanic

1. Validation of the calibration in-the-large VA women CVD risk score with an updated S(5)

2. Calibration intercepts and slopes for N-H white women are 21.075 and 2.787, 16.68 and 2.389 for N-H Black women and 9.778 and 1.289 for Hispanic women. The calibration plots suggest it needs new alpha coefficients to downwards adjust the VA women CVD risk score by race group.

3.B.3 Recalibration: The study updated the VA women CVD risk score with S(5), means of risk factors, and a coefficient (α^*) for the recalibration model $S(5)^* \exp [\alpha^*(x\beta)]$ with the VA women veteran newly enrollees data to the VA women CVD risk score stratified by race/ethnicity group.

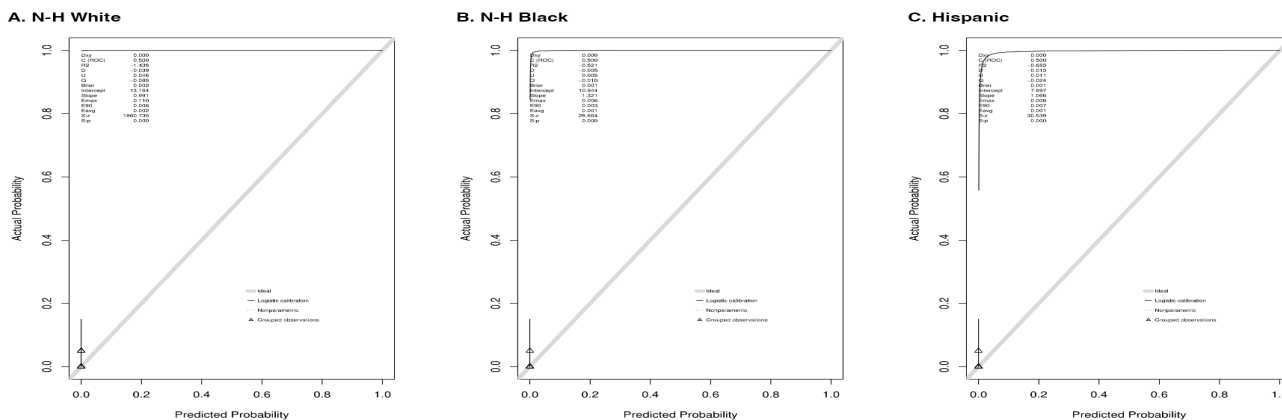
Stratified by race/ethnicity group, likelihood ratio (LR) and H-L tests were conducted to compare a model fit of the VA women CVD risk score with calibration in-the-large and recalibration models (Table 3.B.2).

Table 3.B.2. Recalibration of VA women CVD risk score with new S(5) and alpha coefficients by race group

	New S(5)	alpha	Significantly different from the original predicted model		Calibration plot	
			Log-Likelihood ratio test	Hosmer-Lemeshow	Intercept	Slope
White	0.9833	2.81	-10.51469 (p=1.00)	85.33 (p<0.001)	13.164	0.991
Black	0.9929	1.81	0.0755376 (p=1.000)	0.0059 (p=1.00)	10.944	1.321
Hispanic	0.9913	1.21	-7.6053 (p=1.00)	0.0011 (p=0.9999)	7.697	1.066

Notes. S(5) = 5-year survival

Figure 3.B.3. Validation plots of recalibration of the VA women CVD risk score



Notes. N-H= Non-Hispanic

1. Validation of the recalibrated VA women CVD risk score with an updated S(5) and adjusted risk score downwards by multiplying alpha coefficients

The calibration plots of recalibrated VA women CVD risk score with S(5) showed a poor fit to predict a 10-year ASCVD risk in new VA women enrollees. A new S(10) may be needed to fit the VA women CVD risk score. Since there is no data available beyond 5 year follow up, getting S(10) would need extrapolation.

3.B.4. Extrapolation of S(10) from observed S(5)

We used parametric survival models to extrapolate a long-term survival, a 10 year ASCVD event free survival, from observed data, 5 year follow-up, from the newly enrolled VA women veterans since 2018. Due to only 5 year available data, 2018 until 2022, the study extrapolates a 10 year survival, S(10), for recalibration.

Table 3.B.3 showed the extrapolated S(10)s from parametric models.

Table 3.B.3. Extrapolation to S(10)

Parametric Models	S(10)
Weibull PH	0.996
Weibull right censored	0.994
Log Logistic	0.995

Note. PH = Proportional Hazard

3.C. Active women service members DaVINCI

DaVINCI data on active women service members who received direct care from military health care system between January 1, 2007 and Dec 31, 2022 were used to externally validate and recalibrate the VA women CVD risk score.

Table 3.C.1. Hosmer-Lemeshow (H-L) tests of the original VA CVD score (no update with DaVINCI data)

decile	White, n=47,283 (53%)		Black, n= 29,646 (33%)		Hispanic, n=12,417 (14%)	
	observed	predicted	observed	predicted	observed	predicted
1	0.00058	0.011417	0.00056	0.011417	0.00035	0.010081

2	0.00113	0.018243	0.00113	0.018243	0.00030	0.014586
3	0.00154	0.025496	0.00154	0.025496	0.00131	0.018898
4	0.00248	0.034206	0.00248	0.034206	0.001573	0.023762
5	0.00278	0.044445	0.00278	0.044445	0.001712	0.029391
6	0.00324	0.056735	0.00324	0.056735	0.001887	0.036002
7	0.00427	0.072088	0.00427	0.072088	0.002114	0.044159
8	0.00599	0.093511	0.00599	0.093511	0.002795	0.055352
9	0.00688	0.130666	0.00688	0.130666	0.003669	0.074129
10	0.01097	0.246684	0.01097	0.246684	0.005732	0.138675
H-L stats (p value)	2.2005 (p=0.9742)		2.0706 (p=0.9131)		1.3072 (p=0.9713)	

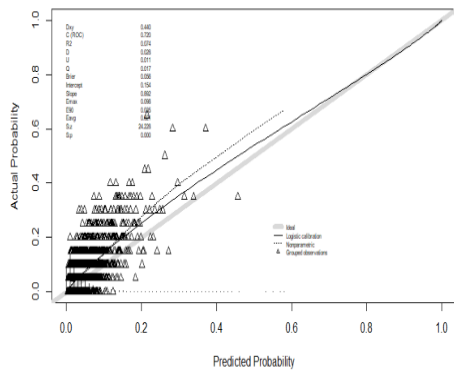
Notes. H-L = Hosmer-Lemeshow;

The study first validated the original VA women CVD risk scores using DaVINCI data set using H-L test and calibration plots. We then did calibration-in-the-large with updating S(10) with new S(10) from DaVINCI data set. We conducted H-L and likelihood ratio tests to inform the goodness of fit of the VA women CVD risk score to predicting 10 year CVD risk of active women service members.

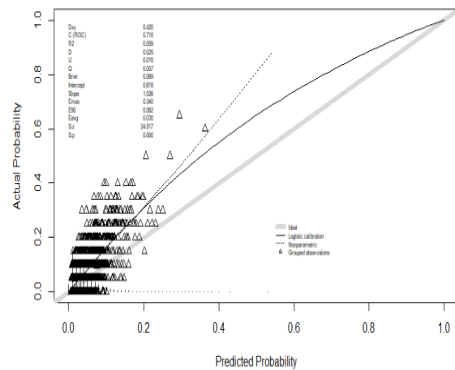
Figure 3.C.1 shows validation plots of the original VA women CVD risk score using DaVINCI data.

Figure 3.C.1. External validation of the VA women CVD risk score

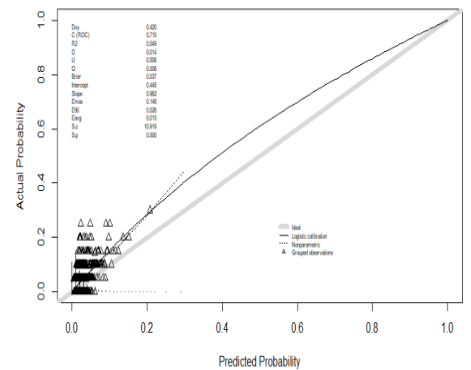
A. N-H White



B. N-H Black



C. Hispanic



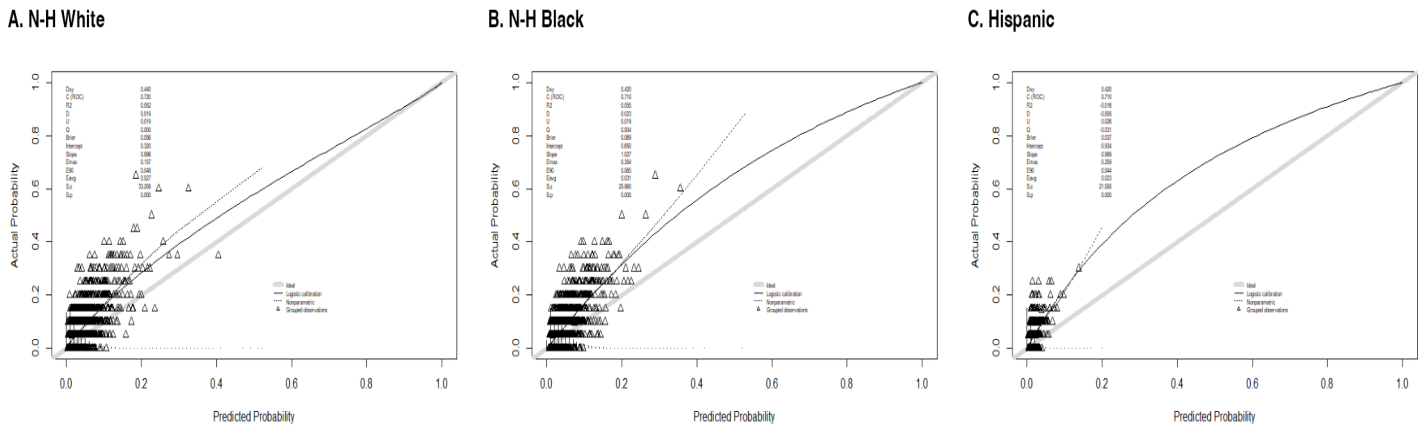
Notes. N-H = Non-Hispanic

1. Calibration plots of the VA women CVD risk scores using DaVINCI

- Calibration intercepts and slopes for N-H white women are 0.154 and 0.892, 0.618 and 1.026 for N-H Black women and 0.445 and 0.982 for Hispanic women.

3.C.3. Calibration in the large: The study updated S(10) and the means of risk factors with the DaVINCI data sets to the VA women CVD risk score stratified by race/ethnicity group.

Figure 3.C.2. Validation plots of calibration in-the-large



Notes. N-H= Non-Hispanic

- Validation of the calibration in-the-large VA women CVD risk score with an updated S(10)
- Calibration intercepts and slopes for N-H white women are 0.320 and 0.896, 0.650 and 1.027 for N-H Black women and 0.934 and 0.989 for Hispanic women.

3.C.4. Recalibration: The study updated the VA women CVD risk score with a new S(10), means of risk factors, and a coefficient (α^*) for the recalibration model $S(10)^* \exp[\alpha^*(x\beta)]$ with the DaVINCI data sets to the VA women CVD risk score stratified by race/ethnicity group.

The study conducted Hosmer-Lemeshow (H-L) tests of original VA women CVD risk score as it is and VA women CVD risk score updated with new S(10), mean risk factors using DaVINCI data set, and multiplication of a coefficient (α^*).

Stratified by race/ethnicity group, likelihood ratio (LR) tests were conducted to compare a model fit of the VA women CVD risk score with calibration in the large and recalibration models (Table x).

The VA women CVD risk score was externally validated with different women populations, civilians and active service members, from the original development cohort. The VA women CVD risk score calibrated in the large, updated with S(10), predicted ASCVD event risk at 10 years well for all civilian across three race and ethnic groups, N-H white, N-H black, and Hispanic civilian women. For N-H white civilian women and active women service members, the VA women CVD risk score did not need any recalibration, while calibrated in-the-large VA women CVD risk score with an updated S(10) predicted 10 year ASCVD risk for N-H Black civilian women and active women service members.

The VA women CVD risk score was well validated to N-H white and Hispanic women active service members (DaVINCI data) who were much younger than the original cohort, the calibrated in-the-large VA women CVD risk score was fitted well for N-H Black active women service member DaVINCI population (calibration intercept ≈ 0 and slope ≈ 1).

The VA women CVD risk scores were fitted well to non-VA women who were not in the original cohort with a follow up of 10 years. The VA women CVD risk score for women veterans newly enrolled since 2018 until 2022 was not validated due to lack of number of ASCVD events in 5 years. Extrapolation of S(10) using parametric survival models still failed due to insufficient ASCVD event numbers in new VA women enrollee data.

5. Discussion

The VA women CVD risk score whose development cohort was VA women was externally validated with the non-VA women including civilians and active service members. The VA women CVD risk score was well validated with the non-VA population different from the original VA women cohort in military exposure and ages. The VA women CVD risk score was validated with external data sets, DHS 1&2—civilian women with a smaller sample size and DaVINCI younger active military population—from the original development VA women cohort. However, the external validation of the VA women CVD risk score with a much smaller sample size and shorter follow-up time presented challenges—new VA women enrollees. To overcome this, we introduced parametric survival models to extrapolate much longer survival beyond the available data. Albeit this, external validation presented a challenge due to insufficient number of ASCVD event numbers and lack of follow up in new VA women enrollees since 2018. The next steps to address challenges are: 1) non-parametric survival models to extrapolate S(10) for new VA women enrollees and simulate ASCVD events at 10 year follow up and to externally validate the VA women CVD risk score to the new VA enrollees and 2) Update the

original VA women development cohort by adding these new VA women enrollees and validate the VA women CVD risk score.

The study used existing methods of validation—H-L and likelihood tests—calibration plots and its intercepts and slopes to assess fit of goodness of models—the VA women CVD risk score. The H-L and Likelihood ratio (LR) tests were not informative in external validation of the VA women CVD risk scores with external data sets, while calibration plots and its intercepts and slopes were informative—a calibration plot close to or approximation of a 45 degree line with a perfect fit, intercept =0 and slope =1. However, there was no statistical tests available to examine whether the intercept and slope are significantly different from a perfect fit (intercept =0 and slope =1). The study team will explore and develop a new method in testing these and the findings of Aim 1 will be written as a manuscript and submitted for a publication in peer-reviewed journals such as Journal of American Heart Association (JAHA).

In conclusion, the VA women risk score is proved to be valid to assess 10 year CVD risk for both the VA and non-VA women, thus it is well suited to serve as a basis model to a new next-generation female sex-specific personalized CVD risk score proposed as the next aim, Aim 2. The specific Aim 2 is to develop and internally validate a new next-generation female sex-specific personalized CVD risk score using women from VA CDW, DaVINCI and MVP data.

What opportunities for training and professional development has the project provided?

"Nothing to Report."

How were the results disseminated to communities of interest?

"Nothing to Report."

What do you plan to do during the next reporting period to accomplish the goals?

The study plan to:

- a. develop a methodology of recalibration with a shorter observed survival data—extrapolation of longer survival using parametric and non-parametric survival models*
- b. present results of Aim 1 at Joint of Statistical Meeting (JSM) and/or American Heart Association (AHA), write a manuscript and submit to a peer-reviewed journal such as JAHA/Circulation.*
- c. execute Aim 2 and accomplish Aim 2.*

Specific Aim 2: Develop and internally validate a new next-generation female sex-specific personalized CVD risk score

- d. Create a development cohort*
- e. Data extraction*
 - Complete MVP GWAS data on 58,970 women veteran participants, 34,310 white women veterans, 16,500 African Americans, 5,500 Hispanic, 2,100 American Indians/Alaskan Natives, 1,179 Asian American, 390 Native Hawaiians/Pacific Islanders, 390 other race, and 660 unknown race.
 - Complete female sex-specific variable data extraction

4. IMPACT:

- **What was the impact on the development of the principal discipline(s) of the project?**
 - *"Nothing to Report."*
- **What was the impact on other disciplines?**
 - *"Nothing to Report."*
- **What was the impact on technology transfer?**
 - *"Nothing to Report."*
- **What was the impact on society beyond science and technology?**

- *"Nothing to Report."*

5. CHANGES/PROBLEMS:

"Nothing to Report,"

- a. **Changes in approach and reasons for change**

"Nothing to report"

- b. **Actual or anticipated problems or delays and actions or plans to resolve them**

"Nothing to report"

- c. **Changes that had a significant impact on expenditures**

"Nothing to report"

- d. **Significant changes in use or care of human subjects, vertebrate animals, biohazards, and/or select agents**

"Nothing to report"

- e. **Significant changes in use or care of human subjects**

"Nothing to report"

- f. **Significant changes in use or care of vertebrate animals.**

"Nothing to report"

- g. **Significant changes in use of biohazards and/or select agents**

"Nothing to report"

6. PRODUCTS:

"Nothing to Report."

Publications, conference papers, and presentations

"Nothing to report"

Journal publications.

"Nothing to report"

Books or other non-periodical, one-time publications.

Other publications, conference papers, and presentations.

Website(s) or other Internet site(s)

Technologies or techniques

Inventions, patent applications, and/or licenses

Other Products

7. PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS

a. What individuals have worked on the project?

Name:	Haekyung Jeon-Slaughter, PhD
Project Role:	<i>PI</i>
Researcher Identifier (e.g. ORCID ID):	<i>0000-0002-5753-2935</i>
Nearest person month worked:	<i>2.4 months</i>
Contribution to Project:	Project lead and management; IRB and HRPSO approval; obtaining data sets and maintain requirements; modeling and inferences; data analysis and statistical modeling; writing results and a manuscript; communication
Funding Support:	<i>N/A</i>
Name:	<i>Shirling Tsai, MD</i>
Project Role:	<i>Co-I</i>
Researcher Identifier (e.g. ORCID ID):	
Nearest person month worked:	<i>1.2</i>
Contribution to Project:	<i>Local IRB approval; statistical modelling and inferences; external validation and recalibration of the VA women CVD risk score using VA new enrollees and DaVINCI data sets</i>
Funding Support:	<i>N/A</i>
Name:	<i>Dian Cao, MD</i>

Project Role:	<i>Co-I</i>
Researcher Identifier (e.g. ORCID ID):	
Nearest person month worked:	<i>1.2 months</i>
Contribution to Project:	<i>Local IRB approval; statistical modelling and inferences; external validation and recalibration of the VA women CVD risk score using the Dallas Heart Study (DHS) data set; writing results and manuscript.</i>
Funding Support:	<i>N/A</i>
Name:	<i>Bala Ramanan, MD</i>
Project Role:	<i>Co-I</i>
Researcher Identifier (e.g. ORCID ID):	
Nearest person month worked:	<i>0.6 month</i>
Contribution to Project:	<i>Statistical modelling, estimation, and inferences in Cox regression analysis; model specification, its performance and recalibration; writing results and a manuscript</i>
Funding Support:	<i>N/A</i>
Name:	<i>Monica Barbosa, MD</i>
Project Role:	<i>Co-I</i>
Researcher Identifier (e.g. ORCID ID):	
Nearest person month worked:	<i>0.6 month</i>
Contribution to Project:	<i>Statistical modelling, estimation, and inferences in Cox regression analysis;</i>

	<i>model specification, its performance and recalibration; writing results and a manuscript</i>
Funding Support:	<i>N/A</i>
Name:	<i>Erum Z. Whyne, PhD</i>
Project Role:	<i>Program analyst</i>
Researcher Identifier (e.g. ORCID ID):	
Nearest person month worked:	<i>12 months</i>
Contribution to Project:	<i>Data extraction of new VA enrollees and DaVINCI data; Data preparation for analysis: transformation, missing data imputation, and coding of predictors; Data analysis;</i>
Funding Support:	<i>N/A</i>
Name:	<i>Erika Shults</i>
Project Role:	<i>Graduate Student</i>
Researcher Identifier (e.g. ORCID ID):	
Nearest person month worked:	<i>4 months</i>
Contribution to Project:	<i>Erika Shults has performed data extraction, imputing data, preparing DHS data set for analysis, data analysis and graphic analysis including recalibration of the VA women CVD risk score using DHS 1 and 2 data sets, estimation of Cox model and its performance, and calibration plots.</i>
Funding Support:	<i>N/A</i>

b. Has there been a change in the active other support of the PD/PI(s) or senior/key personnel since the last reporting period?

i. *"Nothing to Report."*

c. **What other organizations were involved as partners?**

i. *"Nothing to Report."*

8. SPECIAL REPORTING REQUIREMENTS

a. **COLLABORATIVE AWARDS:** *N/A*

b. **QUAD CHARTS:** *N/A*

9. APPENDICES:

None