SUPPLEMENTAL MATERIAL

Data S1. Supplemental Methods

Calculating and Interpreting Absolute Standardized Differences

The absolute standardized difference (ASD) is calculated by taking the difference in means of a covariate across treatment groups and then dividing that difference by the combined standard deviation of both groups ([mean group 1] – [mean group 2] / standard deviation). In general, absolute standardized differences of ≤ 0.1 are considered to represent differences of small magnitude.

Table S1. Baseline characteristics of linked versus unlinked American Heart Association Registry participants

	Linked patients n = 10,009	Unlinked patients n = 11,308	Absolute Standardized Difference*
Patient-level sociodemographic characteristics			
Age (year), Mean (SD)	78.0 (8.5)	76.5 (8.1)	0.17
Female, N (%)	4,837 (48.3)	5450 (48.2)	<0.01
Race, N (%)†			0.26
White	7,546 (75.4)	7,242 (64.0)	0.25
Black	1,436 (14.3)	2,400 (21.2)	0.18
Other	1,027 (10.3)	1,666 (14.7)	0.14
Region, N (%)†,‡			0.14
Midwest	1,822 (18.2)	1,752 (15.5)	0.0.7
Northeast	3,591 (35.9)	4,830 (42.7)	0.14
South	3,492 (34.9)	3,614 (32.0)	0.06
West	1103 (11.0)	1,111 (9.8)	0.04
Chronic comorbidities, N (%)			
Hypertension	7,725 (77.2)	8,791 (77.7)	0.01
Diabetes	3,925 (3.2)	4,933 (43.6)	0.01
Heart failure	2,079 (20.8)	2,118 (18.7)	0.05
Myocardial infarction	1,028 (10.3)	1,072 (9.5)	0.03
Peripheral arterial disease	490 (4.9)	529 (4.7)	0.01
Stroke/TIA	1,668 (16.7)	1,610 (14.2)	0.07
Smoking	614 (6.1)	760 (6.7)	0.02
Chronic kidney disease	2,071 (20.7)	2,172 (19.2)	0.04
COPD	1,689 (16.9)	1,858 (16.4)	0.01
Asthma	761 (7.6)	901 (8.0)	0.01
Community-level sociodemographic characteristics§			
RUCA, N (%)†			0.14
Metro	8,442 (84.5)	10,018 (88.8)	0.13
Micro	683 (6.8)	560 (5.0)	0.08
Small-town/rural	868 (8.7)	699 (6.2)	0.09

*Absolute standardized difference (ASD) is calculated by taking the difference in means of a covariate across treatment groups, divided by the combined standard deviation of both groups. Multivariate Mahalanobis distance was used for multinomial variables.

† Categorical variables may not sum to 1 due to rounding

‡ Puerto Rico and Guam (0.13%) were excluded for the region variable

§ Based on beneficiary ZIP code

Figure S1. Sample SAS Code for Linkage of AHA COVID-19 Cardiovascular Disease Registry with External Data

```
/*******************************************************/
/** Link dataset X and Y**/
/** Dataset X is the smaller one **/
/** *_ID: the ID variable in data X/Y**/
/** adate_*: the admission date in X/Y **/
/** ddate_*: the discharge date in X/Y **/
/** bdate_*: the birth date in X/Y **/
/** bday_*,bmonth_*,byear_*: 3 elements (day, month, year) of the
birth date in X/Y **/
/** prov_num: provider number (hospital ID)**/
/** No missing of these variables in X or Y**/
/*******************************************************/

/*-------------------------------------------------------
Step 1 all 7 factors
-------------------------------------------------------*/;
proc sql noprint;
create table temp as select a.*,b.*
from  x as a
left join Y as b
on compress(a.prov_num) = compress(b.prov_num) and
   a.gender = b.gender and
   a.adate_x= b.adate_y and
   a.bdate_x= b.bdate_y and
   a.ddate_x= b.ddate_y and
   a.zip_x= b.zip_y  and
   a.race_x = b.race_y
;
quit;

data matched1;
set TEMP;
where missing(Y_ID) = 0 ;
length Matched $120.;
matched = '1 all factors' ;
drop adate_x bdate_x ddate_x zip_x race_x
     bday_x bday_y
      bmonth_x bmonth_y
      byear_x byear_y ;
run;

data matched;
set matched1 ;
run;
```

```
/*-----------------------------------------
 Step #2 without race
-----------------------------------------*/

proc sql noprint;
create table finder_x as select distinct * from x where X_ID not in
(select X_ID from  matched);
create table master as select distinct * from Y where Y_ID not in
(select Y_ID from  matched);

create table TEMP as select a.*, b.*
from finder_x as a
left join master as b
on a.prov_num = b.prov_num and
   a.gender = b.gender and
   a.adate_x= b.adate_y and
   a.bdate_x= b.bdate_y and
   a.ddate_x= b.ddate_y and
   a.zip_x= b.zip_y
;
quit;

data matched2;
set TEMP;
where missing(Y_ID) = 0 ;
length Matched $120.;
matched = '2 wo race' ;
drop adate_x bdate_x ddate_x zip_x race_x
     bday_x bday_y
      bmonth_x bmonth_y
      byear_x byear_y ;
run;

data matched;
set matched1 matched2 ;
run;


/*-----------------------------------------
 Step #3 without zipcode
-----------------------------------------*/

proc sql noprint;
create table finder_x as select distinct * from x where X_ID not in
(select X_ID from  matched);
create table master as select distinct * from Y where Y_ID not in
(select Y_ID from  matched);

create table TEMP as select a.*, b.*
from finder_x as a
left join master as b
on a.prov_num = b.prov_num and
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   a.gender = b.gender and
   a.adate_x= b.adate_y and
   a.bdate_x= b.bdate_y and
   a.ddate_x= b.ddate_y and
   a.race_x = b.race_y
;
quit;

data matched3;
set TEMP;
where missing(Y_ID) = 0 ;
length Matched $120.;
matched = '3 wo zip' ;
drop adate_x bdate_x ddate_x zip_x race_x
     bday_x bday_y
      bmonth_x bmonth_y
      byear_x byear_y ;
run;

data matched;
set matched1 matched2 matched3 ;
run;



/*-------------------------------------------------------------
 Step #4 open an 1-day window for dates of admission and discharge
-------------------------------------------------------------*/
proc sql noprint;
create table finder_x as select distinct * from x where X_ID not in
(select X_ID from  matched);
create table master as select distinct * from Y where Y_ID not in
(select Y_ID from  matched);

create table TEMP as select a.*, b.*
from finder_x as a
left join master as b
on a.prov_num = b.prov_num and
   a.gender = b.gender and
   abs(a.adate_x - b.adate_y) < 2 and
   abs(a.ddate_x - b.ddate_y) < 2 and
   a.bdate_x= b.bdate_y and
   a.race_x = b.race_y  and
   a.zip_x= b.zip_y
;
quit;

data matched4;
set TEMP;
where missing(Y_ID) = 0 ;
length Matched $120.;
matched = '4 7 factor with 1d win for a/d date' ;
```

```
drop adate_x bdate_x ddate_x zip_x race_x
     bday_x bday_y
      bmonth_x bmonth_y
      byear_x byear_y ;
run;

data matched;
set matched1 - matched4 ;
run;


/*-----------------------------------------------------------
 Step #5 open a 2-day window for dates of admission and discharge
-----------------------------------------------------------*/
proc sql noprint;
create table finder_x as select distinct * from x where X_ID not in
(select X_ID from  matched);
create table master as select distinct * from Y where Y_ID not in
(select Y_ID from  matched);

create table TEMP as select a.*, b.*
from finder_x as a
left join master as b
on a.prov_num = b.prov_num and
   a.gender = b.gender and
   abs(a.adate_x - b.adate_y) < 3 and
   abs(a.ddate_x - b.ddate_y) < 3 and
   a.bdate_x= b.bdate_y and
   a.race_x = b.race_y  and
   a.zip_x= b.zip_y
;
quit;

data matched5;
set TEMP;
where missing(Y_ID) = 0 ;
length Matched $120.;
matched = '5 7 factor with 2d win for a/d date' ;
drop adate_x bdate_x ddate_x zip_x race_x
     bday_x bday_y
      bmonth_x bmonth_y
      byear_x byear_y ;
run;

data matched;
set matched1 - matched5 ;
run;

/*-----------------------------------------------------------
 Step #6 open a 7-day window for dates of admission and discharge
-----------------------------------------------------------*/
proc sql noprint;
```

```
create table finder_x as select distinct * from x where X_ID not in
(select X_ID from  matched);
create table master as select distinct * from Y where Y_ID not in
(select Y_ID from  matched);

create table TEMP as select a.*, b.*
from finder_x as a
left join master as b
on a.prov_num = b.prov_num and
   a.gender = b.gender and
   abs(a.adate_x - b.adate_y) < 8 and
   abs(a.ddate_x - b.ddate_y) < 8 and
   a.bdate_x= b.bdate_y and
   a.race_x = b.race_y  and
   a.zip_x= b.zip_y
;
quit;

data matched6;
set TEMP;
where missing(Y_ID) = 0 ;
length Matched $120.;
matched = '6 7 factor with 7d win for a/d date' ;
drop adate_x bdate_x ddate_x zip_x race_x
     bday_x bday_y
      bmonth_x bmonth_y
      byear_x byear_y ;
run;

data matched;
set matched1 - matched6 ;
run;

/*-------------------------------------------------------------
 Step #7 without zipcode and 1-day window for dates of admission and
discharge
-------------------------------------------------------------*/
proc sql noprint;
create table finder_x as select distinct * from x where X_ID not in
(select X_ID from  matched);
create table master as select distinct * from Y where Y_ID not in
(select Y_ID from  matched);

create table TEMP as select a.*, b.*
from finder_x as a
left join master as b
on a.prov_num = b.prov_num and
   a.gender = b.gender and
   abs(a.adate_x - b.adate_y) < 2 and
   abs(a.ddate_x - b.ddate_y) < 2 and
   a.bdate_x= b.bdate_y and
   a.race_x = b.race_y
```

```
;
quit;

data matched7;
set TEMP;
where missing(Y_ID) = 0 ;
length Matched $120.;
matched = '7 wo zip and 1d win for a/d date' ;
drop adate_x bdate_x ddate_x zip_x race_x
     bday_x bday_y
      bmonth_x bmonth_y
      byear_x byear_y ;
run;

data matched;
set matched1 - matched7 ;
run;

/*-------------------------------------------------------------
 Step #8 without race and 1-day window for dates of admission and
discharge
-------------------------------------------------------------*/
proc sql noprint;
create table finder_x as select distinct * from x where X_ID not in
(select X_ID from  matched);
create table master as select distinct * from Y where Y_ID not in
(select Y_ID from  matched);

create table TEMP as select a.*, b.*
from finder_x as a
left join master as b
on a.prov_num = b.prov_num and
   a.gender = b.gender and
   abs(a.adate_x - b.adate_y) < 2 and
   abs(a.ddate_x - b.ddate_y) < 2 and
   a.bdate_x= b.bdate_y and
   a.zip_x= b.zip_y
;
quit;

data matched8;
set TEMP;
where missing(Y_ID) = 0 ;
length Matched $120.;
matched = '8 wo race and 1d win for a/d date' ;
drop adate_x bdate_x ddate_x zip_x race_x
     bday_x bday_y
      bmonth_x bmonth_y
      byear_x byear_y ;
run;

data matched;
```

```
set matched1 - matched8 ;
run;

/*-------------------------------------------------------
 Step #9 without race, zip, and 1-day window for dates of admission
and discharge
-------------------------------------------------------*/
proc sql noprint;
create table finder_x as select distinct * from x where X_ID not in
(select X_ID from  matched);
create table master as select distinct * from Y where Y_ID not in
(select Y_ID from  matched);

create table TEMP as select a.*, b.*
from finder_x as a
left join master as b
on a.prov_num = b.prov_num and
   a.gender = b.gender and
   abs(a.adate_x - b.adate_y) < 2 and
   abs(a.ddate_x - b.ddate_y) < 2 and
   a.bdate_x= b.bdate_y
;
quit;

data matched9;
set TEMP;
where missing(Y_ID) = 0 ;
length Matched $120.;
matched = '9 wo race/zip and allow 1d win for a/d date' ;
drop adate_x bdate_x ddate_x zip_x race_x
     bday_x bday_y
      bmonth_x bmonth_y
      byear_x byear_y ;
run;

data matched;
set matched1 - matched9 ;
run;


/*-------------------------------------------------------
 Step #10 without race, zip, discharge
-------------------------------------------------------*/
proc sql noprint;
create table finder_x as select distinct * from x where X_ID not in
(select X_ID from  matched);
create table master as select distinct * from Y where Y_ID not in
(select Y_ID from  matched);

create table TEMP as select a.*, b.*
from finder_x as a
left join master as b
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```
on a.prov_num = b.prov_num and
   a.gender = b.gender and
   a.adate_x = b.adate_y and
   a.bdate_x= b.bdate_y
;
quit;


data matched10;
set TEMP;
where missing(Y_ID) = 0 ;
length Matched $120.;
matched = '10 wo race zip discharge date' ;
drop adate_x bdate_x ddate_x zip_x race_x
     bday_x bday_y
      bmonth_x bmonth_y
      byear_x byear_y ;
run;

data matched;
set matched1 - matched10 ;
run;

/*-------------------------------------------------------------
 Step #11 without race, zip, admission
-------------------------------------------------------------*/
proc sql noprint;
create table finder_x as select distinct * from x where X_ID not in
(select X_ID from  matched);
create table master as select distinct * from Y where Y_ID not in
(select Y_ID from  matched);

create table TEMP as select a.*, b.*
from finder_x as a
left join master as b
on a.prov_num = b.prov_num and
   a.gender = b.gender and
   a.ddate_x = b.ddate_y and
   a.bdate_x= b.bdate_y
;
quit;

data matched11;
set TEMP;
where missing(Y_ID) = 0 ;
length Matched $120.;
matched = '11 wo race zip admission date' ;
drop adate_x bdate_x ddate_x zip_x race_x
     bday_x bday_y
      bmonth_x bmonth_y
      byear_x byear_y ;
run;
```

```
data matched;
set matched1 - matched11 ;
run;

/*-----------------------------------------------------------
 Step #12 without race, zip, 2 out of 3 dob
-----------------------------------------------------------*/
proc sql noprint;
create table finder_x as select distinct * from x where X_ID not in
(select X_ID from  matched);
create table master as select distinct * from Y where Y_ID not in
(select Y_ID from  matched);

create table TEMP as select a.*, b.*
from finder_x as a
left join master as b
on a.prov_num = b.prov_num and
   a.gender = b.gender and
   a.ddate_x = b.ddate_y and
   a.adate_x = b.adate_y and
   ((a.bday_x =  b.bday_y and a.bmonth_x = b.bmonth_y) or (a.bday_x =
b.bday_y and a.byear_x = b.byear_y) or ( a.bmonth_x = b.bmonth_y and
a.byear_x = b.byear_y))
;
quit;

data matched12;
set TEMP;
where missing(Y_ID) = 0 ;
length Matched $120.;
matched = '12 wo race zip and 2/3 element of dob' ;
drop adate_x bdate_x ddate_x zip_x race_x
     bday_x bday_y
      bmonth_x bmonth_y
      byear_x byear_y ;
run;

data matched;
set matched1 - matched12 ;
run;

/*-----------------------------------------------------------
 Step #13 without race, zip, 2 out of 3 dob, 1d win for a/d date
-----------------------------------------------------------*/
proc sql noprint;
create table finder_x as select distinct * from x where X_ID not in
(select X_ID from  matched);
create table master as select distinct * from Y where Y_ID not in
(select Y_ID from  matched);

create table TEMP as select a.*, b.*
```

```
from finder_x as a
left join master as b
on a.prov_num = b.prov_num and
   a.gender = b.gender and
   abs(a.ddate_x - b.ddate_y) <1 and
   abs(a.adate_x - b.adate_y) <1 and
   ((a.bday_x =  b.bday_y and a.bmonth_x = b.bmonth_y) or (a.bday_x =
b.bday_y and a.byear_x = b.byear_y) or ( a.bmonth_x = b.bmonth_y and
a.byear_x = b.byear_y))
;
quit;

data matched13;
set TEMP;
where missing(Y_ID) = 0 ;
length Matched $120.;
matched = '13 wo race zip and 2/3 element of dob, 1d win' ;
drop adate_x bdate_x ddate_x zip_x race_x
     bday_x bday_y
      bmonth_x bmonth_y
      byear_x byear_y ;
run;

data final_matched;
set matched1 - matched13 ;
run;
```