

## Supplementary Online Content

Khera R, Kondamudi N, Zhong L, et al. Temporal trends in heart failure incidence among Medicare beneficiaries across risk factor strata, 2011 to 2016. *JAMA Netw Open*. 2020;3(10):e2022190. doi:10.1001/jamanetworkopen.2020.22190

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This supplementary material has been provided by the authors to give readers additional information about their work.

**eTable 1.** International Classification of Disease (ICD) 9 & 10 Codes Used to Identify Medicare Beneficiaries with Prevalent Primary and Secondary Heart Failure Risk Factors

<b>Hypertension</b>	ICD 9 diagnoses including '4011','4019','4010','40200','40201','40210','40211','40290','40291','4030','40300','40301','4031','40310','40311','4039','40390','40391','4040','40400','40401','40402','40403','4041','40410','40411','40412','40413','4049','40490','40491','40492','40493','40501','40509','40511','40519','40591','40599','4372' or ICD 10 CCS diagnosis groups '98','99'
<b>Diabetes</b>	ICD9 diagnoses including '24900','25000','25001','7902','79021','79022','79029','7915','7916','V4585','V5391','V6546','24901','24910','24911','24920','24921','24930','24931','24940','24941','24950','24951','24960','24961','24970','24971','24980','24981','24990','24991','25002','25003','25010','25011','25012','25013','25020','25021','25022','25023','25030','25031','25032','25033','25040','25041','25042','25043','25050','25051','25052','25053','25060','25061','25062','25063','25070','25071','25072','25073','25080','25081','25082','25083','25090','25091','25092','25093') or ICD 10 CC diagnosis groups '49','50'
<b>Atrial Fibrillation</b>	ICD9 diagnoses including '42731' or ICD 10 diagnosis I48.xx
<b>Obesity</b>	ICD9 diagnoses including '2780','27800','27801','27802','27803','79391','V8521','V8522','V8523','V8524','V8525','V8530','V8531','V8532','V8533','V8534','V8535','V8536','V8537','V8538','V8539','V854','V8541','V8542','V8543','V8544','V8545','V8554','Z6841','Z6842','Z6843','Z6844','Z6845' or ICD 10 diagnosis group with E66
<b>Acute Myocardial Infarction</b>	ICD9 substrate CD1. 1,3) in ('410') and substrate CD1,5,5) not in ('2') or ICD 10 CCS diagnosis group '100'

Abbreviations: CCS, clinical classification software; ICD, International Classification of Disease

**eTable 2.** Clinical Characteristics of Medicare Beneficiaries Without Prevalent Heart Failure in the Beginning of Each Calendar Year During the Study Period<sup>a</sup>

	2011	2012	2013	2014	2015	2016
N	1,426,256	1,422,429	1,432,268	1,433,868	1,431,496	1,416,971
Age (y), median, IQR	73 (68,79)	73 (68,79)	73 (68,79)	73 (68,79)	73 (68,79)	73 (69,79)
Men, %	621196 (43.6)	621381 (43.7)	627489 (43.8)	629180 (43.9)	628102 (43.9)	620718 (43.8)
Race, N, %						
White	1219137 (85.5)	1213534 (85.3)	1218383 (85.1)	1215060 (84.7)	1208495 (84.4)	1192235 (84.1)
Black	118292 (8.3)	117147 (8.2)	117008 (8.2)	117074 (8.2)	116528 (8.1)	115047 (8.1)
Others	85265 (6)	86004 (6)	87590 (6.1)	88696 (6.2)	90039 (6.3)	90394 (6.4)
Unknown	3562 (0.2)	5744 (0.4)	9287 (0.6)	13038 (0.9)	16434 (1.1)	19295 (1.4)
Region, N, %						
Northeast	259523 (18.2)	256304 (18)	256241 (17.9)	254448 (17.7)	251785 (17.6)	247030 (17.4)
Midwest	338546 (23.7)	335989 (23.6)	336255 (23.5)	334731 (23.3)	332330 (23.2)	327981 (23.1)
South	549788 (38.5)	548933 (38.6)	553830 (38.7)	555981 (38.8)	556845 (38.9)	552658 (39)
West	257678 (18.1)	260442 (18.3)	265494 (18.5)	269115 (18.8)	272210 (19)	272638 (19.2)
Others	18875 (1.3)	18432 (1.3)	18066 (1.3)	17613 (1.2)	17080 (1.2)	16662 (1.2)
Comorbidity, N, %						
Myocardial Infarction	25987 (1.8)	32083 (2.3)	31353 (2.2)	30356 (2.1)	29725 (2.1)	29394 (2.1)
Peripheral Vascular Disease	109420 (7.7)	144026 (10.1)	139465 (9.8)	136529 (9.5)	134915 (9.4)	135626 (9.6)
Cerebrovascular Disease	119628 (8.4)	137364 (9.7)	133590 (9.3)	129848 (9.1)	125912 (8.8)	122278 (8.6)
Dementia	29968 (2.1)	40645 (2.9)	38113 (2.7)	36089 (2.5)	34600 (2.4)	47162 (3.3)
Chronic Pulmonary Disease	156977 (11)	187962 (13.2)	185654 (13)	184552 (12.9)	182267 (12.8)	184045 (13)
Rheumatic Disease	37874 (2.7)	43750 (3.1)	42816 (3)	41871 (2.9)	41445 (2.9)	41768 (3)
Peptic Ulcer Disease	11127 (0.8)	14703 (1)	14072 (1)	13404 (0.9)	12744 (0.9)	12341 (0.9)
Mild Liver Disease	31878 (2.2)	40875 (2.9)	41555 (2.9)	41572 (2.9)	42857 (3)	44438 (3.1)

Diabetes without Complication	274214 (19.2)	288508 (20.3)	285087 (19.9)	282276 (19.7)	277724 (19.4)	274126 (19.4)
Diabetes with Complication	54610 (3.8)	73515 (5.2)	74527 (5.2)	76440 (5.3)	78501 (5.5)	86855 (6.1)
Renal Disease	60669 (4.3)	82484 (5.8)	86578 (6.1)	91990 (6.4)	96516 (6.8)	102736 (7.3)
Cancer	136923 (9.6)	146272 (10.3)	144522 (10.1)	143560 (10)	142285 (10)	141619 (10)
AIDS/HIV	1055 (0.1)	1141 (0.1)	1197 (0.1)	1212 (0.1)	1270 (0.1)	1266 (0.1)
Charlson's score, median, IQR	0 (0,1)	0 (0,2)	0 (0,2)	0 (0,2)	0 (0,2)	0 (0,2)

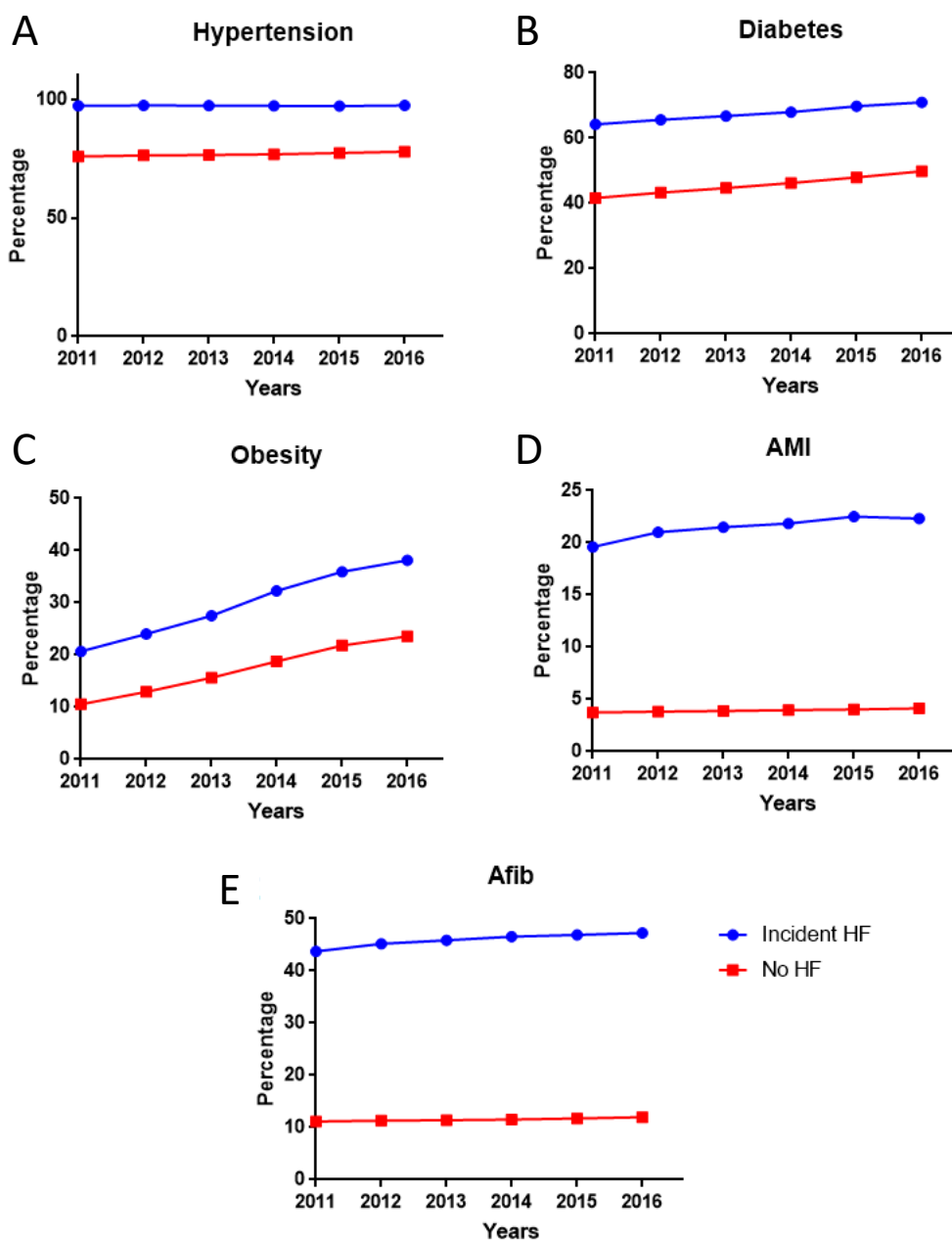
**eTable 3.** Studies Reporting Heart Failure Incidence Trends (presented in chronologic order)

<b>Author (Year)</b>	<b>Country</b>	<b>Study Period</b>	<b>Codes Used to Identify Heart Failure</b>	<b>Heart failure Incidence Trend</b>
Curtis et al. (2008) <sup>1</sup>	United States	1994-2003	ICD-9: 428.XX, 402.X1, or 404.X3	32 per 1,000 to 29 per 1,000 persons (age-adjusted), from <b>1994 to 2003</b>
Jhund et al. (2009) <sup>2</sup>	Scotland	1986-2003	ICD-9 codes: 425.4, 425.5, 425.9, 428.0, 428.1, 428.9, or 402 ICD-10 codes: I50, I42.0, I42.6, I42.7, or I42.9)	Men: 1.2 per 1,000 to 1.1 per 1,000 persons Women: 1.3 per 1,000 to 1 per 1,000 persons (age adjusted) from <b>1986 to 2003</b>
Teng et al (2010) <sup>3</sup>	Australia	1990-2005	ICD-9 codes: 428x, 402.01, 402.11, 402.91, 404.1, 404.3, 425x, 518.4, 514, 391.8, and 398.91 ICD-10 codes: I50x, I11.0, I13.0, I13.2, I42x, J81, I01.8, I020	Men: 1.9 per 1,000 to 1 per 1,000 persons Women: 1.3 per 1,000 to 0.8 per 1,000 persons (age adjusted), from <b>1990 to 2005</b>
Ezekowitz et al. (2011) <sup>4</sup>	Canada	2000-2006	ICD-9 codes: 428.x ICD-10 code: I50	5 per 1,000 to 4 per 1,000 persons (age-adjusted) from <b>2000 to 2006</b>

Zarrinkoub et al (2013) <sup>5</sup>	Sweden	2006-2010	ICD-10 code: I50	Men: 4 per 1,000 to 3 per 1,000 persons Women: 4 per 1,000 to 3 per 1,000 persons (age adjusted) from <b>2006 to 2010</b>
Gerber et al (2015) <sup>6</sup>	United States	2000-2010	ICD-9 codes: 428, 425, 429.3, and 514	3 per 1,000 to 2 per 1,000 persons (age and sex adjusted) from <b>2000 to 2010</b>
Christiansen et al. (2017) <sup>7</sup>	Denmark	1995-2012	ICD-10 codes: DI50, DI110, DI42, DI43, DI130, DI132, DO903 ICD-8 codes: 427.09, 427.10, 427.11, 427.19, 428.99, 428.49	Adjusted (age and sex) incident rate ratios ≤50 years old: 1.02 (0.89–1.83) to 1.52 (1.33–1.73) >50 years old: 1.02 (0.99–1.05) to 0.69 (0.67–0.71) from <b>1995 to 2012</b>
Khera et al. (2017) <sup>8</sup>	United States	2002-2013	ICD-9 codes: 428.x, 402.x1, 404.x1, and 404.x3	39 per 1,000 to 26 per 1,000 persons (age adjusted) <b>2002 to 2013</b>

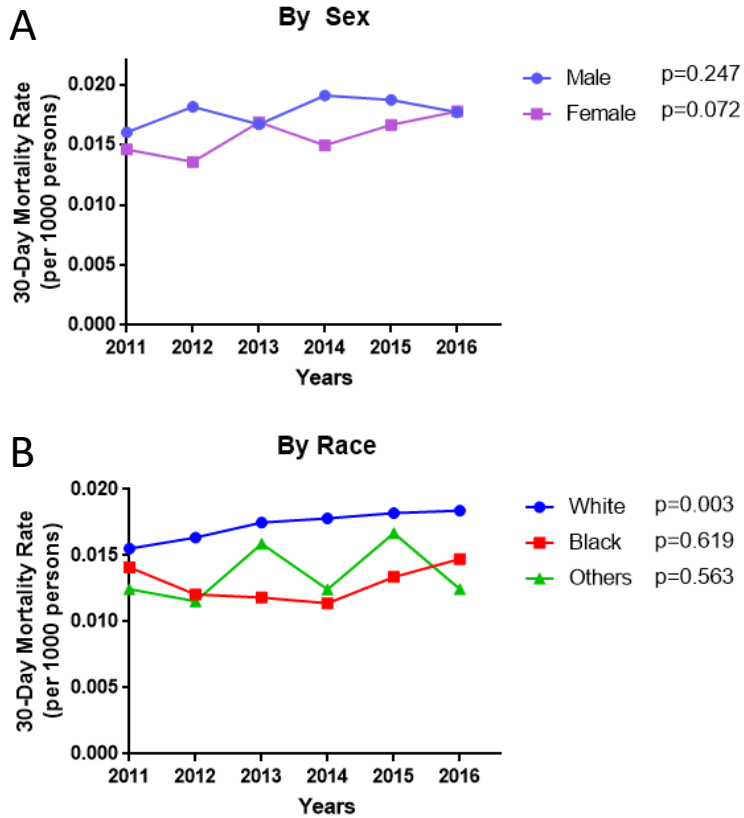
Tsao et al (2018) <sup>9</sup>	United States	1990-2009	Incident heart failure diagnoses adjudicated by physician panel	20 per 1,000 to 19 per 1,000 persons from <b>1990–1999 to 2000–2009</b>
Conrad et al. (2018) <sup>10</sup>	United Kingdom	2002-2014	ICD-10 codes: I50.0, I50.1, I50.9, I42.0, I42.9, I11.0, I25.5, I13.2, I13.0 Primary care read codes: G581.00, G58.00, G580.11, G5yy900, G55..00, 585f.00, G58..11, G581.133, 33BA.00, 101..00, G5yyA00, G551.00, G41z.11, G58z.00, G554400, 662g.00, G581000, G580.12, G554300, 1O1..00, G580.14, G343.00, G58z.12, 662h.00, G582.00, G58z.00, G5yyD00, 6622f.00, G583.00, G580100, G555.00, G580.13, G55y.11, G580200, 8H2S.00, 8H2S.00, G554200, G583.12, G584.00, G554000, G580300, G559.00, G583.11, 8CMW800, G580400, G558100, Gyu5M00, G1yz100, 662i.00, 661M500, 8CMK.00, G21z100, G211100, G232.00, 8CeC.00	4 per 1,000 to 3 per 1,000 persons (age and sex adjusted), from <b>2002 to 2014</b>
Sulo et al. (2020) <sup>11</sup>	Norway	2000-2014	ICD-9 codes: 402.01, 402.11, 402.3, 402.7, 402.91, 425.4, 425.5, 425.9, 428, 428.x  ICD-10 codes: I09.81, I11.0, I50, and I50	Men: 2,055 to 1,805 persons Women: 1,962 to 1,625 persons Incident heart failure cases from <b>2000 to 2014</b>

**eFigure 1.** Percentage of Beneficiaries in Each Comorbid Group Among Those Who Developed Heart Failure and Those Who Did Not Develop Heart Failure, Yearly Trend. Hypertension (A), Diabetes (B), Obesity (C), Acute Myocardial Infarction (D), and Atrial Fibrillation (E). AF: Atrial fibrillation; AMI: Acute myocardial infarction.

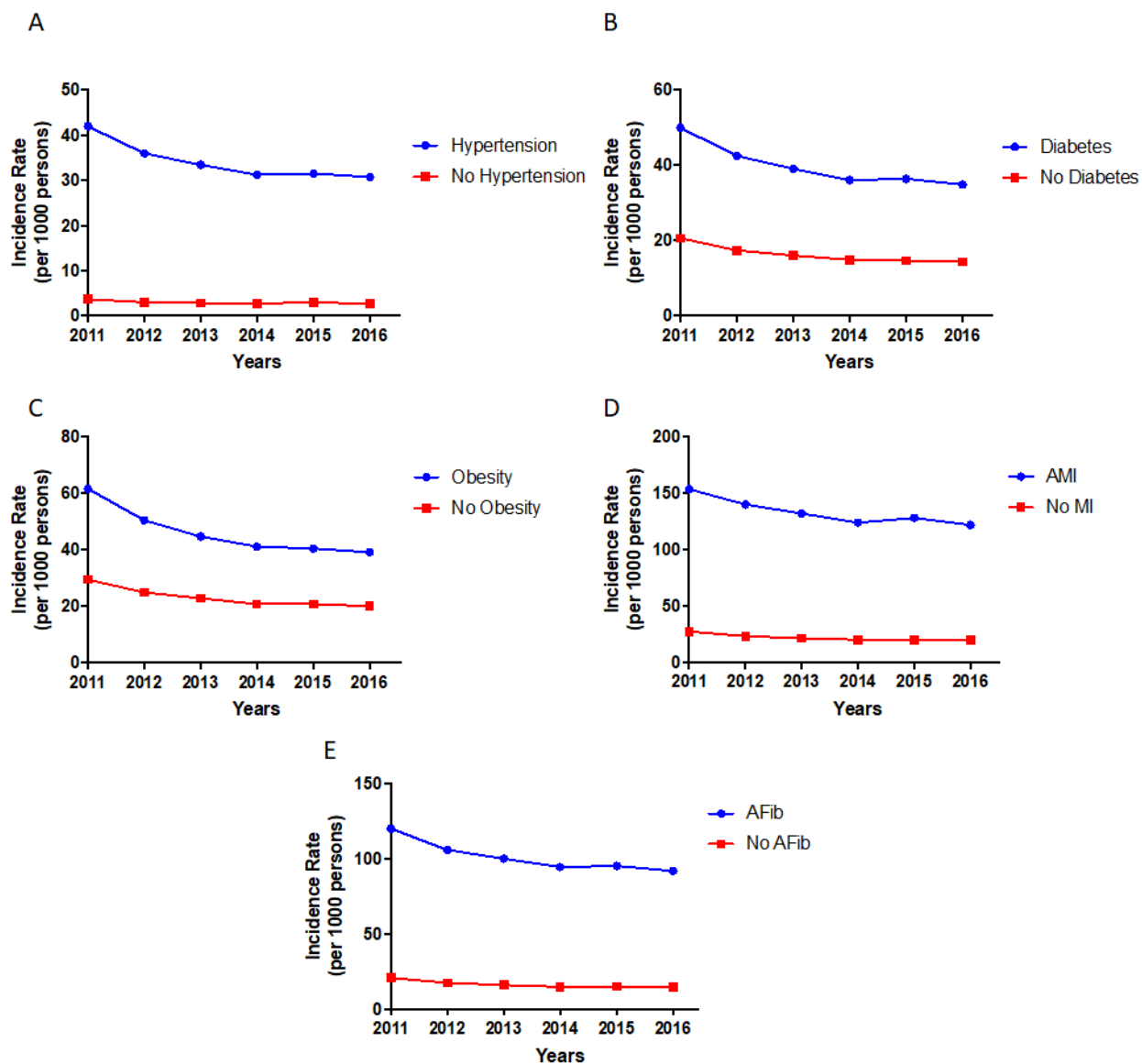




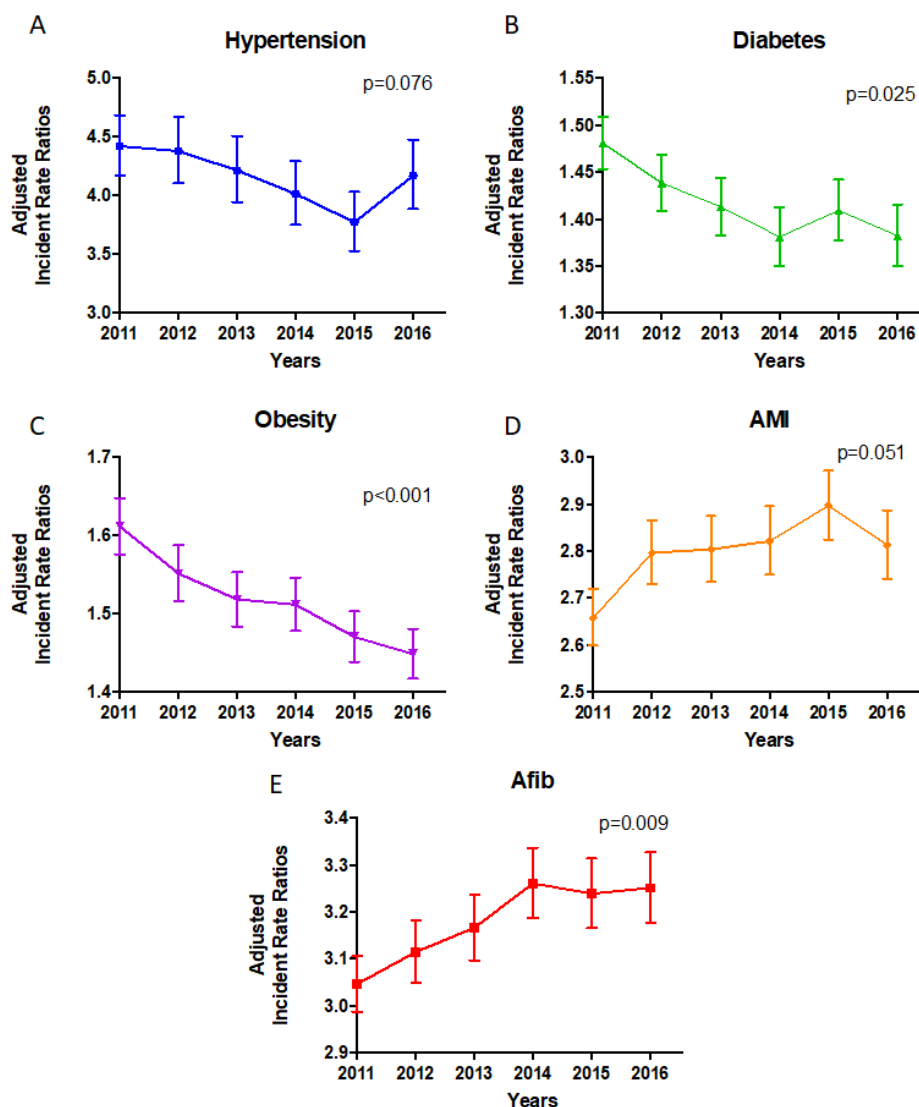
**eFigure 2.** 30-day Unadjusted Mortality Rate Among Beneficiaries with Incident Heart Failure Stratified by Sex (A) and Race (B), Yearly Trend. The p-value reflects trends in the mortality rate over time. (Mortality rate per 1000 persons)



**eFigure 3.** Incident Rate of Heart Failure Among Beneficiaries by Comorbid Groups: Hypertension (A), Diabetes (B), Obesity (C), Acute Myocardial Infarction (D), and Atrial Fibrillation (E), Yearly Trend. AF: Atrial fibrillation; AMI: Acute myocardial infarction. 2-year period of claims used to exclude prevalent heart failure.



**eFigure 4.** Adjusted Incidence Rate Ratios for Heart Failure Among Beneficiaries With vs. Without Each Risk Factor Over Time, Hypertension (A), Diabetes (B), Obesity (C), Acute Myocardial Infarction (D), and Atrial Fibrillation (E), Yearly Trend. Poisson regression models were constructed to determine the association of each risk factor with HF incidence for each year with adjustment for age, sex, race, socioeconomic status, and all 5 risk factors. The p-value reflects trends in the incidence rate ratio over time. AF: Atrial fibrillation; AMI: Acute myocardial infarction. 2-year period of claims used to exclude prevalent heart failure.



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