

Distinguishing primary and secondary prevention

implantable cardioverter defibrillators using administrative health and cardiac device registry data

Supplementary Material

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Supplemental Table S1: Data sources

Health Data	Source
ICD implantation data	Cardiac Services BC (CSBC) cardiac device registries (CDR and HEARTis)
Medical Services Plan registration	Consolidation File
Hospitalization records	Discharge Abstract Database (DAD)
Physician services	BC Medical Service Plan (MSP)
Prescription drug fill data	PharmaNet
Residential neighbourhood-level household income	Income Band database
Date and cause of death	Vital Statistics database

- **Cardiac Services BC:** Cardiac Services BC. Vancouver, BC: Provincial Health Services Authority, 2021. <http://www.cardiacbc.ca/>
 - Cardiac Devices registry (1995-2013); HEARTis registry (2013-2019)
- **Consolidation File:** British Columbia Ministry of Health [creator] (2020): Consolidation File (MSP Registration & Premium Billing). V2. Population Data BC [publisher]. Data Extract. MOH (2020). <http://www.popdata.bc.ca/data>
- **Discharge Abstract Database:** Canadian Institute for Health Information [creator] (2020): Discharge Abstract Database (Hospital Separations). V2. Population Data BC [publisher]. Data Extract. MOH (2020). <http://www.popdata.bc.ca/data>
- **Medical Services Plan:** British Columbia Ministry of Health [creator] (2020): Medical Services Plan (MSP) Payment Information File. Population Data BC [publisher]. Data Extract. MOH (2020). <http://www.popdata.bc.ca/data>
- **PharmaNet:** British Columbia Ministry of Health [creator] (2020): PharmaNet. V2. Population Data BC [publisher]. Data Extract. Data Stewardship Committee (2020). <http://www.popdata.bc.ca/data>
- **Income Band:** Statistics Canada [creator]: Statistics Canada Income Band Data. Catalogue Number: 13C0016. V2. Population Data BC [publisher]. Data Extract. Population Data BC (2020). <http://www.popdata.bc.ca/data>
- **Vital Statistics:** British Columbia Ministry of Health [creator] (2020): Vital Events Deaths. V2. Population Data BC [publisher]. Data Extract. MOH (2020). <http://www.popdata.bc.ca/data>

All inferences, opinions and conclusions drawn in this manuscript are those of the authors and do not reflect the opinions or policies of the Data Stewards. Access to data provided by the Data Stewards is subject to approval but can be requested for research projects through the Data Stewards or their designated service providers.

Supplemental Table S2: Candidate variables to predict ICD indication using administrative health data

Variables	Definition
Demographic	
Age	Age in years; continuous.
Male sex	Sex recorded as male (reference: sex recorded as female, unknown, or missing).
Residential neighbourhood household income quintile	Residential neighbourhood income quintile generated by PopData using census data and patient residential postal code (1 = lowest income quintile*, 5 = highest income quintile; ordinal).
Health services use	
Total days in hospital in the past Year	Continuous variable for the number of days in hospital in the year before implantation date.
Physician visits in the past year	Number of physician/clinic visits in the year before implantation date; 0 visits*, ≤ 1 per month (1-12 visits); ≤ 1 per week (13-52 visits); > 1 per week (>52 visits)
Recent hospitalization for myocardial infarction	Discharge date of hospitalization with Most Responsible Diagnosis corresponding to myocardial infarction (see diagnostic codes in Appendix Supplemental Table S3) ≤6 weeks prior to implantation date.
Index visit deemed 'urgent' instead of 'elective'	DAD's ADMIT variable is 'U' (urgent) instead of 'L' (elective) or any other response.
Prolonged length of stay	Index visit length of stay ≥3 days.
Selected index visit Most Responsible Diagnoses	Identified within the Discharge Abstract Database entry for the index visit for ICD implantation; see Supplemental Table S3 for specific diagnostic codes. Specific MRDs of interest include cardiac arrest; ventricular tachycardia and fibrillation; other arrhythmias; syncope; pacemaker; presence of ICD; heart failure; myocardial infarction OR unstable angina; chronic ischemic heart disease.
Comorbidities	
CCI in the past year	Dichotomized variable for CCI ≥2 (yes/no).
Selected comorbidities	Comorbidities were deemed to be present if the associated diagnostic codes were found in ≥1 hospitalization or ≥2 clinic visits in the year before index date. ¹ Specific comorbidities of interest and their corresponding diagnostic codes are listed in Supplemental Table S3 .
Medications	
Number of active prescription medications at index date	Number of active prescription medications at index date (0*, 1, ≥2 distinct medications).
Selected medication cases	Medications were deemed to be present if active at implantation date, based on prescription fill date and days supplied.

Legend. Potential health variables obtained from administrative health datasets that may be predictive of ICD indication when it is missing from cardiac registry datasets. * indicates the referent. DAD, Discharge Abstract Database; CCI, Charlson Comorbidity Index; MRD, Most responsible diagnosis.

Supplemental Table S3: Diagnostic codes used to identify comorbidities in administrative health data

Condition	Codes
Myocardial infarction	ICD9: 410, 412; ICD10: I21, I22, I252
Congestive heart failure	ICD9: 39891, 402, 404, 425, 428; ICD10: I43, I50, I099, I110, I130, I132, I255, I420, I425, I426, I427, I428, I429, P290
Peripheral vascular disease	ICD9: 0930, 437, 440, 441, 443, 4471, 5571, 5579, V434; ICD10: I70, I71, I731, I738, I739, I771, I790, I792, K551, K558, K559, Z958, Z959
Cerebrovascular disease	ICD9: 36234, 430-438; ICD10: G45, G46, I60-I69, H340
Dementia	ICD9: 290, 2941, 3312; ICD10: F00-F03, G30, F051, G311
Chronic obstructive pulmonary disease	ICD9: 4168, 4169, 490-496, 500-505, 5064, 5081, 5088; ICD10: J40-J47, J60-J67, I278, I279, J684, J701, J703
Rheumatic disease	ICD9: 4465, 7100-7104, 7140-7142, 7148, 725; ICD10: M05, M32-M34, M06, M315, M351, M353, M360
Peptic ulcer disease	ICD9: 531-534; ICD10: K25-K28
Mild liver disease	ICD9: 07022, 07023, 07032, 07033, 07044, 07054, 0706, 0709, 570, 571, 5733, 5734, 5738, 5739, V427; ICD10: B18, K73, K74, K700-K703, K709, K717, K713-K715, K760, K762- K764, K768, K769, Z944
Diabetes without complications	ICD9: 2500-2503, 2508, 2509; ICD10: E100, E101, E106, E108, E109, E110, E111, E116, E118, E119, E120, E121, E126, E128, E129, E130, E131, E136, E138, E139, E140, E141, E146, E148, E149
Diabetes with complications	ICD9: 2504-2507; ICD10: E102- E105, E107, E112-E115, E117, E122-E125, E127, E132-E135, E137, E142-E145, E147
Paraplegia and hemiplegia	ICD9: 3341, 342, 343, 3440-3446, 3449; ICD10: G81, G82, G041, G114, G801, G802, G830-G834, G839
Renal disease	ICD9: 403, 404, 582, 5830, 5831, 5832, 5834, 5836, 5837, 585, 586, 5880, V420, V451, V56; ICD10: N18, N19, N052-N057, N250, I120, I131, N032-N037, Z490-Z492, Z940, Z992
Cancer	ICD9: 140-165, 170-172, 174-176, 179-195, 200- 208, 2386; ICD10: C00-C26, C30-C34, C37-C41, C43, C45-C58, C60-C76, C81-C85, C88, C90-C97
Moderate or severe liver disease	ICD9: 4560-4562, 5722-5724, 5728; ICD10: K704, K711, K721, K729, K765-K767, I850, I859, I864, I982
Metastatic carcinoma	ICD9: 196-199; ICD10: C77-C80
HIV	ICD9: 042; ICD10: B20-B24
Syncope	ICD9: 7802; ICD10: R55
Atrial fibrillation and flutter	ICD9: 427; ICD10: I48
Other arrhythmias	ICD9: 426, 427, 74686, 7850; ICD10: I44-I47, I49, R00
Presence of AICD	ICD9: 99604, V4502, V5332; ICD10: Z9501, Z9502, Z4501, Z4502
Seizure disorders	ICD9: 345, 78033; ICD10: G40, R5680
Obstructive sleep apnea and other sleep disorders	ICD9: 307, 327, 3270, 32711, 32712, 3272, 32720, 32721, 32723, 32724, 32726, 32727, 32729, 3273, 32730, 32731, 32732, 32733, 32734, 32735, 32736, 32737, 32739, 32742, 32743, 3275, 32752, 32753, 32759, 3278, 7805, 78050, 78051, 78053, 78055-78059, V694; ICD10: F51, G47
Traumatic brain injury	ICD9: 310, 80009, 80019, 80029, 80039, 80049, 80059, 80069, 80079, 80089, 80099, 80109, 80119, 80129, 80139, 80149, 80159, 80169, 80179, 80189, 80199, 80309, 80319, 80329, 80339, 80349, 80359, 80369, 80379, 80389, 80399, 80409, 80419, 80429, 80439, 80449, 80459, 80469, 80479, 80489, 80499, 850, 8500, 85011, 85012, 8502, 8503, 8504, 8505, 8509, 85109, 85119, 85129, 85139, 85149, 85159, 85169, 85179, 85189, 85199, 85209,

	85219, 85229, 85239, 85249, 85259, 85309, 85319, 85409, 85419, V1552, V8001; ICD10: F072, S06
Psychiatric disorders	ICD9: 295, 296, 297, 298, 299, 300, 301, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319; ICD10: F04, F05, F06, F07, F08, F09, F2, F3, F4, F5, F6, F7, F8, F9
Alcohol misuse	ICD9: 291, 303, 305, 3575, 4255, 5353, 53530, 53531, 571, 76071, 7903, 9773, 980, E860, V113; ICD10: F10, R780, T51, X45, X65, Y15, Y90, Y91, Z502, Z714, Z721, Z8640
Other substance misuse	ICD9: 292, 304, 305, 76073, 76075, 9650, 96501, 96502, 96509, 967, 9670, 9671, 9676, 9678, 9679, 9696, 96972, 9701, 97081, E8500, E8501, E8502, E851, E852, E8520, E8525, E8528, E8529, E8541, E9350, E9351, E9352, E937, E9370, E9371, E9376, E9378, E9379, E9396, E9401, E9501, E9502, E9801, E9802; ICD10: F11, F12, F13, F14, F15, F16, F17, F18, F19
Chronic ischemic heart disease	ICD9: 414, 4140, 41400, 41401, 41402, 41403, 41404, 41405, 41406, 41407, 4143, 4144, 4148, 4149; ICD10: I25
Hypertension	ICD9: 36211, 401, 402, 403, 404, 405, 6420, 64200, 64201, 64202, 64203, 64204, 6421, 64210, 64211, 64212, 64213, 64214, 6422, 64220, 64221, 64222, 64223, 64224, 6427, 64270, 64271, 64272, 64273, 64274; ICD10: I10, I11, I12, I13, I14, I15, O10, O11
Pacemaker	ICD9: V4501, V5331; ICD10: Z4500, Z9500, z9502, z4502
Cardiac arrest	ICD9: 427, 77985, 798, V1253; ICD10: I46, R96
Ventricular tachycardia and fibrillation	ICD9: 427; ICD10: I472, I490
Unstable angina	ICD9: None; ICD10: I200

Legend. ICD in this table refers to the International Classification of Diseases.

Supplemental Table S4: Registry variables predictive of secondary prevention ICDs in CDR

Variable	ICD implantations with feature, count (%)	Odds ratio (95%CI), p-value	Estimate
Intercept*	3008 (100)	0.06 (0.02, 0.16), p<0.001	-2.8756
History of cardiac arrest, VF, or Brugada syndrome*	570 (19)	2440.86 (768.41, 7753.38), p<0.001	7.8001
History of VT*	1311 (44)	46.25 (27.13, 78.84), p<0.001	3.8340
History of syncope*	669 (22)	9.89 (4.59, 21.30), p<0.001	2.2917
Current medication: Alpha blockers	25 (1)	2.49 (0.45, 13.73), p=0.294	0.9130
Clinical presentation: Syncope	544 (18)	2.13 (0.90, 5.05), p=0.086	0.7564
Primary or final diagnosis of ARVD	11 (0)	2.08 (0.31, 13.89), p=0.449	0.7329
Clinical presentation: Missing*	565 (19)	2.02 (1.34, 3.03), p=0.001	0.7008
Tachyarrhythmia description: Missing	226 (8)	1.75 (0.88, 3.51), p=0.112	0.5623
History of stroke	137 (5)	1.70 (0.81, 3.53), p=0.158	0.5283
History of MI ≤6 weeks prior	102 (3)	1.59 (0.71, 3.54), p=0.256	0.4639
History of ischemic heart failure	333 (11)	1.56 (0.80, 3.03), p=0.19	0.4448
History of heart block	76 (3)	1.51 (0.61, 3.76), p=0.377	0.4113
History of nonischemic heart failure	151 (5)	1.29 (0.47, 3.53), p=0.623	0.2529
Diagnosis of long QT syndrome	46 (2)	1.27 (0.41, 3.92), p=0.682	0.2361
History of hypertension	793 (26)	1.20 (0.83, 1.72), p=0.331	0.1791
Previous congenital heart surgery	11 (0)	1.20 (0.14, 10.26), p=0.868	0.1814
Previous stent/angioplasty	467 (16)	1.17 (0.76, 1.80), p=0.465	0.1598
History of ischemic heart disease	1505 (50)	1.15 (0.66, 1.99), p=0.63	0.1357
History of valvular heart disease	376 (13)	1.14 (0.74, 1.77), p=0.545	0.1342
History of heart failure	1648 (55)	1.11 (0.67, 1.83), p=0.695	0.1006
History of peripheral vascular disease	121 (4)	1.10 (0.57, 2.12), p=0.779	0.0939
History of MI >6 weeks prior	800 (27)	1.09 (0.73, 1.62), p=0.671	0.0860
Current medication: Class III antiarrhythmics	561 (19)	1.06 (0.77, 1.46), p=0.704	0.0616
ICD models C174AWK, D234TRK, or D354TRG	556 (18)	1.03 (0.65, 1.62), p=0.902	0.0285
Current medication: Anti-hyperlipidemics	1477 (49)	1.02 (0.73, 1.41), p=0.923	0.0161
Age in years	Non-binary variable	1.01 (0.99, 1.02), p=0.416	0.0051
Previous acquired heart surgery	606 (20)	1.00 (0.69, 1.46), p=0.986	0.0034
Current medication: ACE inhibitors	1964 (65)	0.99 (0.73, 1.35), p=0.953	-0.0093
Current medication: Diuretics	1449 (48)	0.95 (0.70, 1.30), p=0.754	-0.0492
Male sex	2465 (82)	0.95 (0.65, 1.38), p=0.795	-0.0497
Current medications: None	106 (4)	0.93 (0.41, 2.10), p=0.853	-0.0776
History of diabetes	481 (16)	0.90 (0.60, 1.37), p=0.636	-0.0999
Current medication: Class I antiarrhythmics	16 (1)	0.90 (0.18, 4.42), p=0.901	-0.1013
Current medication: Antiplatelet agents	1501 (50)	0.89 (0.66, 1.19), p=0.42	-0.1201
Current medication: Anticoagulants	943 (31)	0.86 (0.63, 1.18), p=0.342	-0.1518
Clinical presentation: Asymptomatic	377 (13)	0.84 (0.54, 1.31), p=0.449	-0.1705

Current medication: Digoxin	440 (15)	0.84 (0.54, 1.30), p=0.431	-0.1740
Current medication: Class IV antiarrhythmics	198 (7)	0.84 (0.47, 1.49), p=0.549	-0.1745
Current medication: Nitrates	290 (10)	0.83 (0.54, 1.28), p=0.405	-0.1829
No known history of cardiovascular disease	162 (5)	0.76 (0.39, 1.45), p=0.401	-0.2793
Clinical presentation: Heart failure	978 (33)	0.72 (0.45, 1.15), p=0.171	-0.3243
History of coronary artery disease	1713 (57)	0.69 (0.35, 1.33), p=0.267	-0.3766
ICD indication reported to be primary	783 (26)	0.61 (0.35, 1.05), p=0.076	-0.4937
Current medication: Class II antiarrhythmics*	2281 (76)	0.60 (0.43, 0.83), p=0.002	-0.5144
Implantation 'elective' instead of 'urgent'/'emergency'*	2052 (68)	0.57 (0.42, 0.76), p<0.001	-0.5632
History of cardiomyopathy*	871 (29)	0.54 (0.34, 0.84), p=0.006	-0.6243
History of congenital heart disease	40 (1)	0.37 (0.12, 1.10), p=0.074	-1.0025
Tachyarrhythmia description: No tachyarrhythmia*	639 (21)	0.09 (0.05, 0.17), p<0.001	-2.3818

Legend. Table presenting the strength of association between specific clinical registry variables from CDR and ICD indication. Main finding is that predictors of secondary-prevention ICD are plausible. CI, confidence interval; * indicates p<0.05; VT, ventricular tachycardia; MI, myocardial infarction; ARVD, arrhythmogenic right ventricular dysplasia; ACE, angiotensin-converting enzyme.

Supplemental Table S5: Registry variables predictive of secondary prevention in HEARTis

Variable	ICD implantations with feature, count (%)	Odds ratio (95% CI), p-value	Estimate
Intercept	2928 (100)	0.77 (0.37, 1.61), p=0.486	-0.2614
History of cardiac arrest, VF, or Brugada syndrome	475 (16)	512,496,911.17 (0.00, Inf), p=0.96	20.0548
History of VT*	850 (29)	6.39 (4.85, 8.43), p<0.001	1.8554
Left ventricle ejection fraction ≥35% (ref: missing)*	811 (28)	3.96 (2.62, 5.98), p<0.001	1.3761
History of channelopathy*	57 (2)	3.49 (1.23, 9.88), p=0.019	1.2492
History of syncope*	518 (18)	3.12 (2.27, 4.28), p<0.001	1.1370
Current medication: Type I or Type III antiarrhythmics*	497 (17)	2.40 (1.72, 3.37), p<0.001	0.8771
Dual chamber ICD (ref: single chamber)*	1155 (39)	1.77 (1.30, 2.41), p<0.001	0.5716
Left ventricle ejection fraction ≤ 34 (ref: missing)*	1214 (41)	1.64 (1.03, 2.62), p=0.037	0.4974
History of coronary artery disease	668 (23)	1.34 (0.98, 1.84), p=0.065	0.2944
Age in years	Non-binary variable	1.01 (1.00, 1.02), p=0.262	0.0062
Male sex	2329 (80)	1.00 (0.72, 1.39), p=0.988	0.0025
NYHA Class I (ref: missing)	465 (16)	0.96 (0.65, 1.40), p=0.815	-0.0453
NYHA Class IV (ref: missing)	35 (1)	0.92 (0.33, 2.52), p=0.867	-0.0866
History of heart failure	1850 (63)	0.83 (0.55, 1.27), p=0.394	-0.1827
NYHA Class II (ref: missing)*	703 (24)	0.65 (0.47, 0.90), p=0.01	-0.4291
History of atrial tachycardia*	790 (27)	0.62 (0.46, 0.83), p=0.001	-0.4844
NYHA Class III (ref: missing)*	302 (10)	0.55 (0.35, 0.86), p=0.009	-0.6017
CRT ICD (ref: single chamber)*	900 (31)	0.44 (0.31, 0.63), p<0.001	-0.8171
Implantation 'elective' instead of 'urgent'/'emergency'*	1747 (60)	0.06 (0.05, 0.08), p<0.001	-2.8111

Legend. Table presenting the strength of association between specific clinical registry variables used in HEARTis and ICD indication. * indicates p<0.05; VT, ventricular tachycardia; VF, ventricular fibrillation; NYHA, New York Heart Association; CRT, cardiac resynchronization therapy.

Supplemental Table S6: Administrative health data variables predictive of secondary prevention ICDs in the CDR and HEARTis

Variable	ICDs with feature in CDR, count (%)	ICDs with feature in HEARTis, count (%)	CDR odds ratio (95%CI), p-value	HEARTis odds ratio (95%CI), p-value
Intercept	3008 (100)	2928 (100)	0.62 (0.34, 1.13), p=0.117	0.22 (0.09, 0.51), p<0.001*
Implantation 'urgent/emergency' instead of 'elective'	1081 (36)	1445 (49)	1.43 (1.08, 1.89), p=0.014*	4.35 (2.92, 6.47), p<0.001*
Index length of stay 3 or more days	1116 (37)	1437 (49)	1.51 (1.14, 2.00), p=0.004*	2.92 (1.99, 4.30), p<0.001*
Hospitalization for myocardial infarction within 6 weeks of index	101 (3)	158 (5)	1.20 (0.68, 2.12), p=0.527	1.55 (0.78, 3.07), p=0.214
Neighbourhood income quintile (ordinal, 1 low 5 high)	Non-binary variable	Non-binary variable	0.99 (0.93, 1.06), p=0.781	1.04 (0.94, 1.14), p=0.438
Number of days spent in hospital year prior to index	Non-binary variable	Non-binary variable	1.02 (1.01, 1.03), p<0.001*	1.01 (1.00, 1.02), p=0.274
Age (continuous)	Non-binary variable	Non-binary variable	1.00 (0.99, 1.01), p=0.812	1.01 (1.00, 1.02), p=0.236
Male sex	2465 (82)	2324 (79)	1.09 (0.85, 1.41), p=0.497	0.89 (0.63, 1.25), p=0.495
Between 13 and 52 MSP visits in year prior to index (ref: 12 or less)	2051 (68)	2058 (70)	0.88 (0.60, 1.29), p=0.515	0.46 (0.27, 0.77), p=0.003*
Over 52 MSP visits in year prior to index (ref: 12 or less)	753 (25)	629 (21)	0.53 (0.33, 0.85), p=0.008*	0.46 (0.24, 0.90), p=0.023*
Comorbidities at index				
Cardiac arrest	19 (1)	75 (3)	9.25 (1.07, 80.37), p=0.044*	7.60 (0.94, 61.67), p=0.058
Ventricular tachycardia and fibrillation	683 (23)	792 (27)	2.13 (1.63, 2.77), p<0.001*	7.20 (4.80, 10.81), p<0.001*
Syncope	18 (1)	38 (1)	0.91 (0.32, 2.58), p=0.865	2.92 (1.23, 6.91), p=0.015*
Chronic ischemic heart disease	391 (13)	441 (15)	1.20 (0.84, 1.72), p=0.318	1.56 (1.00, 2.45), p=0.052*
Myocardial infarction	36 (1)	69 (2)	2.24 (0.79, 6.32), p=0.127	1.38 (0.57, 3.36), p=0.48
Atrial fibrillation and flutter	62 (2)	110 (4)	0.60 (0.31, 1.17), p=0.133	0.42 (0.21, 0.85), p=0.015*
Congestive heart failure	772 (26)	922 (31)	0.41 (0.31, 0.55), p<0.001*	0.33 (0.23, 0.47), p<0.001*
Other arrhythmias	346 (12)	121 (4)	0.98 (0.72, 1.35), p=0.918	0.16 (0.09, 0.30), p<0.001*
Comorbidities in the year prior to index				

Cardiac arrest	397 (13)	606 (21)	11.69 (7.57, 18.04), p<0.001*	10.02 (6.39, 15.71), p<0.001*
Peptic ulcer disease	30 (1)	18 (1)	0.73 (0.29, 1.85), p=0.504	7.25 (1.58, 33.35), p=0.011*
Pacemaker	N/A	23 (1)	N/A	4.18 (0.99, 17.74), p=0.052
Dementia	19 (1)	20 (1)	1.69 (0.46, 6.14), p=0.426	3.48 (0.59, 20.33), p=0.167
Paraplegia and hemiplegia	10 (0)	≤5	0.54 (0.08, 3.47), p=0.515	3.10 (0.36, 26.45), p=0.302
Ventricular tachycardia and fibrillation	1079 (36)	844 (29)	1.50 (1.22, 1.84), p<0.001*	2.78 (2.02, 3.82), p<0.001*
Alcohol misuse	59 (2)	65 (2)	0.82 (0.40, 1.69), p=0.585	2.40 (0.89, 6.45), p=0.084
Other arrhythmias	2365 (79)	2271 (77)	1.68 (1.29, 2.18), p<0.001*	2.20 (1.52, 3.18), p<0.001*
Hypertension	972 (32)	1061 (36)	1.19 (0.96, 1.48), p=0.119	1.48 (1.08, 2.02), p=0.014*
Obstructive sleep apnea and other sleep disorders	65 (2)	90 (3)	0.59 (0.29, 1.23), p=0.159	1.44 (0.63, 3.32), p=0.39
Binary indicator CCI ≥ 2	1309 (44)	1329 (45)	0.84 (0.61, 1.17), p=0.303	1.40 (0.89, 2.20), p=0.144
Peripheral vascular disease	207 (7)	121 (4)	0.78 (0.52, 1.17), p=0.227	1.28 (0.65, 2.51), p=0.473
Unstable angina	101 (3)	37 (1)	0.67 (0.40, 1.13), p=0.136	1.24 (0.34, 4.61), p=0.744
Other substance misuse	37 (1)	50 (2)	0.73 (0.29, 1.84), p=0.507	1.15 (0.38, 3.48), p=0.811
Rheumatic disease	27 (1)	25 (1)	1.38 (0.48, 4.00), p=0.551	1.06 (0.27, 4.09), p=0.936
Myocardial infarction	733 (24)	681 (23)	1.24 (0.94, 1.64), p=0.132	1.00 (0.66, 1.53), p=0.982
Seizure	18 (1)	33 (1)	1.03 (0.27, 3.91), p=0.97	0.97 (0.26, 3.72), p=0.97
Atrial fibrillation and flutter	534 (18)	594 (20)	1.27 (0.97, 1.67), p=0.084	0.88 (0.60, 1.28), p=0.499
Chronic ischemic heart disease	1370 (46)	1415 (48)	0.95 (0.76, 1.18), p=0.628	0.86 (0.63, 1.18), p=0.342
Diabetes with complications	441 (15)	598 (20)	1.21 (0.86, 1.71), p=0.283	0.86 (0.54, 1.38), p=0.541
Chronic obstructive pulmonary disease	324 (11)	332 (11)	1.27 (0.90, 1.79), p=0.181	0.76 (0.47, 1.21), p=0.243
Cancer	90 (3)	114 (4)	1.54 (0.86, 2.78), p=0.149	0.76 (0.35, 1.63), p=0.477

Syncope	224 (7)	283 (10)	1.60 (1.15, 2.24), p=0.006*	0.73 (0.48, 1.11), p=0.137
Psychiatric disorders	323 (11)	380 (13)	1.09 (0.79, 1.52), p=0.595	0.71 (0.46, 1.08), p=0.107
Renal disease	231 (8)	371 (13)	1.13 (0.76, 1.68), p=0.554	0.66 (0.41, 1.05), p=0.081
Cerebrovascular disease	131 (4)	130 (4)	1.22 (0.75, 1.99), p=0.42	0.57 (0.29, 1.10), p=0.092
Diabetes without complications	245 (8)	170 (6)	1.39 (0.96, 2.03), p=0.083	0.51 (0.28, 0.92), p=0.025*
Mild liver disease	19 (1)	39 (1)	0.25 (0.06, 1.03), p=0.055	0.47 (0.16, 1.44), p=0.188
Congestive heart failure	1950 (65)	1824 (62)	0.50 (0.40, 0.64), p<0.001*	0.41 (0.29, 0.57), p<0.001*
Medications active at index date				
ACEi or ARB	1867 (62)	1631 (56)	0.88 (0.67, 1.16), p=0.382	1.23 (0.82, 1.85), p=0.326
Antihypertensives	2363 (79)	2116 (72)	0.95 (0.66, 1.38), p=0.797	1.05 (0.62, 1.79), p=0.859
Anticoagulants	660 (22)	650 (22)	1.15 (0.88, 1.50), p=0.32	1.04 (0.70, 1.54), p=0.862
Anti-arrhythmics	256 (9)	123 (4)	1.20 (0.85, 1.70), p=0.291	1.02 (0.54, 1.94), p=0.952
Benzodiazepines	357 (12)	243 (8)	0.84 (0.61, 1.17), p=0.309	1.01 (0.61, 1.67), p=0.971
Insulin	143 (5)	150 (5)	0.75 (0.45, 1.25), p=0.273	1.01 (0.48, 2.12), p=0.978
Hydralazine	50 (2)	46 (2)	1.51 (0.72, 3.13), p=0.273	1.01 (0.31, 3.37), p=0.982
Number of active medications (continuous)	Non-binary variable	Non-binary variable	0.97 (0.91, 1.04), p=0.387	0.99 (0.91, 1.07), p=0.791
Anti-platelets	461 (15)	542 (18)	0.89 (0.65, 1.20), p=0.439	0.93 (0.60, 1.44), p=0.734
Calcium channel blockers	276 (9)	229 (8)	1.35 (0.96, 1.90), p=0.083	0.92 (0.52, 1.60), p=0.758
Oral hypoglycemics	463 (15)	504 (17)	1.05 (0.76, 1.46), p=0.775	0.91 (0.57, 1.44), p=0.69
Statins	1448 (48)	1376 (47)	1.02 (0.80, 1.30), p=0.877	0.87 (0.60, 1.26), p=0.462
Nitroglycerin	306 (10)	180 (6)	1.29 (0.92, 1.81), p=0.137	0.87 (0.47, 1.61), p=0.655
Beta blockers	1852 (62)	1688 (58)	0.78 (0.59, 1.03), p=0.077	0.79 (0.52, 1.19), p=0.261
Loop diuretics	1094 (36)	821 (28)	0.80 (0.62, 1.03), p=0.086	0.70 (0.48, 1.03), p=0.072

MRA	788 (26)	830 (28)	0.61 (0.47, 0.79), p<0.001*	0.60 (0.41, 0.88), p=0.009*
Opioids	191 (6)	201 (7)	1.23 (0.80, 1.91), p=0.346	0.56 (0.30, 1.05), p=0.072
Digoxin	489 (16)	143 (5)	0.97 (0.72, 1.29), p=0.821	0.54 (0.27, 1.08), p=0.081

Legend. Table presenting the strength of association between specific administrative variables and ICD indication in the HEARTis and CDR study intervals. CI, confidence interval; * indicates p<0.05; MSP, Medical Services Plan; CCI, Charlson comorbidity index; ACEi, angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker; MRA, Mineralocorticoid receptor antagonist.

Supplemental Table S7: Combined registry and administrative health data variables predictive of secondary prevention ICDs in CDR

Variable	ICD implantations with feature, count (%)	Odds ratio (95%CI), p-value	Estimate
Intercept*	3008 (100)	0.04 (0.01, 0.14), p<0.001	-3.1452
History of cardiac arrest, VF, or Brugada syndrome*	570 (19)	2577.09 (747.97, 8879.20), p<0.001	7.8544
History of VT*	1311 (44)	45.53 (26.53, 78.13), p<0.001	3.8184
Clinical presentation: Syncope*	552 (18)	6.03 (3.02, 12.03), p<0.001	1.797
History of cardiac arrest*	397 (13)	5.64 (2.71, 11.73), p<0.001	1.7291
Hydralazine*	50 (2)	4.75 (1.29, 17.46), p=0.019	1.5573
History of syncope*	753 (25)	2.94 (1.74, 4.94), p<0.001	1.0769
Current medication: Alpha blockers	25 (1)	2.44 (0.45, 13.24), p=0.3	0.8938
History of cancer	90 (3)	2.17 (0.92, 5.09), p=0.076	0.7729
History of chronic obstructive pulmonary disease*	324 (11)	2.01 (1.22, 3.31), p=0.006	0.6972
History of stroke	137 (5)	1.99 (0.92, 4.32), p=0.08	0.6896
History of seizure	18 (1)	1.92 (0.29, 12.58), p=0.496	0.6533
Primary or final diagnosis of ARVD	11 (0)	1.77 (0.27, 11.79), p=0.554	0.5720
Chronic ischemic heart disease at index	391 (13)	1.64 (0.96, 2.80), p=0.07	0.4950
Clinical presentation: Missing*	565 (19)	1.62 (1.07, 2.44), p=0.022	0.4823
History of heart block	76 (3)	1.62 (0.62, 4.24), p=0.323	0.4846
Other arrhythmias at index*	346 (12)	1.50 (1.02, 2.20), p=0.039	0.4057
History of other arrhythmias	2365 (79)	1.46 (0.97, 2.19), p=0.071	0.3752
Tachyarrhythmia description: Missing	226 (8)	1.44 (0.69, 3.00), p=0.332	0.3631
History of MI ≤6 weeks prior	176 (6)	1.43 (0.76, 2.70), p=0.272	0.3567
History of nonischemic heart failure	151 (5)	1.35 (0.48, 3.78), p=0.568	0.2999
ICD models C174AWK, D234TRK, or D354TRG	556 (18)	1.31 (0.81, 2.12), p=0.272	0.2701
Calcium channel blockers	276 (9)	1.31 (0.79, 2.19), p=0.301	0.2700
Implantation 'urgent/emergency' instead of 'elective'	1081 (36)	1.29 (0.83, 2.00), p=0.255	0.2540
Beta blockers	1852 (62)	1.26 (0.84, 1.88), p=0.262	0.2289
History of renal disease	231 (8)	1.24 (0.69, 2.24), p=0.47	0.2171
History of hypertension	1405 (47)	1.23 (0.89, 1.70), p=0.202	0.2084
Previous stent/angioplasty	467 (16)	1.23 (0.79, 1.91), p=0.368	0.2042
History of ischemic heart failure	1499 (50)	1.22 (0.88, 1.68), p=0.235	0.1967
History of diabetes	765 (25)	1.22 (0.76, 1.95), p=0.408	0.1978
History of psychiatric disorders	323 (11)	1.17 (0.71, 1.93), p=0.545	0.1547
Myocardial infarction at index	36 (1)	1.16 (0.27, 5.01), p=0.841	0.1495
History of valvular heart disease	376 (13)	1.15 (0.72, 1.81), p=0.562	0.136
Between 13 and 52 MSP visits in year prior to index (ref: 12 or less)	2051 (68)	1.13 (0.65, 1.97), p=0.653	0.1263
Over 52 MSP visits in year prior to index (ref: 12 or less)	753 (25)	1.13 (0.56, 2.30), p=0.726	0.1265
History of ischemic heart disease	1505 (50)	1.12 (0.63, 1.98), p=0.697	0.1137
Diagnosis of long QT syndrome	46 (2)	1.12 (0.35, 3.60), p=0.853	0.1108
History of rheumatic disease	27 (1)	1.08 (0.26, 4.56), p=0.918	0.0753
Previous congenital heart surgery	11 (0)	1.07 (0.13, 8.68), p=0.951	0.0654
History of paraplegia and hemiplegia	10 (0)	1.07 (0.09, 12.28), p=0.957	0.0672

Current medication: Anti-hyperlipidemics	1477 (49)	1.06 (0.75, 1.51), p=0.722	0.0628
Previous acquired heart surgery	606 (20)	1.04 (0.70, 1.55), p=0.835	0.0419
History of dementia	19 (1)	1.02 (0.14, 7.59), p=0.986	0.0182
Anticoagulants	1117 (37)	1.01 (0.72, 1.43), p=0.946	0.0119
Current medication: Digoxin	616 (20)	1.01 (0.67, 1.51), p=0.978	0.0057
Number of days spent in hospital year prior to index	Non-binary variable	1.00 (0.99, 1.02), p=0.605	0.0032
Age in years	Non-binary variable	1.00 (0.99, 1.02), p=0.542	0.0042
History of MI >6 weeks prior	1283 (43)	1.00 (0.68, 1.46), p=0.982	-0.0045
History of atrial fibrillation and flutter	534 (18)	1.00 (0.67, 1.49), p=0.989	-0.0029
Benzodiazepines	357 (12)	1.00 (0.62, 1.62), p=1	-0.0001
Antihypertensives	2363 (79)	1.00 (0.58, 1.73), p=0.988	0.0042
Current medication: Class III antiarrhythmics	561 (19)	0.99 (0.71, 1.39), p=0.968	-0.0070
Statins	1448 (48)	0.99 (0.68, 1.43), p=0.955	-0.0106
Insulin	143 (5)	0.99 (0.43, 2.24), p=0.976	-0.0129
Index length of stay 3 or more days	1116 (37)	0.98 (0.63, 1.54), p=0.944	-0.0161
ACEi or ARB	1867 (62)	0.98 (0.60, 1.61), p=0.94	-0.0190
Opioids	191 (6)	0.98 (0.51, 1.87), p=0.943	-0.0236
History of cerebrovascular disease	131 (4)	0.96 (0.44, 2.09), p=0.914	-0.0430
Neighbourhood income quintile (ordinal, 1 low 5 high)	Non-binary variable	0.95 (0.86, 1.05), p=0.295	-0.0520
Atrial fibrillation and flutter at index	62 (2)	0.95 (0.34, 2.65), p=0.917	-0.0547
Number of active medications (continuous)	Non-binary variable	0.94 (0.87, 1.02), p=0.124	-0.0628
MRA	788 (26)	0.93 (0.62, 1.38), p=0.713	-0.0753
Male sex	2465 (82)	0.92 (0.62, 1.38), p=0.692	-0.0806
Oral hypoglycemics	463 (15)	0.92 (0.55, 1.53), p=0.749	-0.0837
Current medication: Class I antiarrhythmics	16 (1)	0.92 (0.17, 4.92), p=0.925	-0.0803
Clinical presentation: Asymptomatic	377 (13)	0.91 (0.58, 1.42), p=0.669	-0.0979
Current medication: Nitrates	481 (16)	0.89 (0.60, 1.31), p=0.545	-0.1218
Current medication: ACE inhibitors	2427 (81)	0.87 (0.52, 1.45), p=0.591	-0.1398
Current medication: Diuretics	1698 (56)	0.83 (0.58, 1.18), p=0.288	-0.1917
History of heart failure	2271 (75)	0.83 (0.55, 1.24), p=0.362	-0.1884
Current medication: Antiplatelet agents	1623 (54)	0.81 (0.60, 1.10), p=0.175	-0.2123
History of coronary artery disease	1713 (57)	0.80 (0.41, 1.58), p=0.519	-0.2232
ICD indication reported to be primary	783 (26)	0.78 (0.44, 1.38), p=0.386	-0.2541
History of peripheral vascular disease	302 (10)	0.76 (0.47, 1.23), p=0.262	-0.2769
Current medication: Class IV antiarrhythmics	198 (7)	0.73 (0.39, 1.37), p=0.327	-0.3161
No known history of cardiovascular disease	162 (5)	0.73 (0.37, 1.43), p=0.361	-0.3125
History of unstable angina	101 (3)	0.72 (0.35, 1.46), p=0.358	-0.3327
History of obstructive sleep apnea and other sleep disorders	65 (2)	0.72 (0.23, 2.25), p=0.569	-0.3334
Clinical presentation: Heart failure	1339 (45)	0.70 (0.49, 1.02), p=0.064	-0.3506
History of alcohol misuse	59 (2)	0.67 (0.20, 2.23), p=0.512	-0.4038
History of peptic ulcer disease	30 (1)	0.66 (0.13, 3.40), p=0.621	-0.413
Implantation 'elective' instead of 'urgent'/'emergency'*	2052 (68)	0.64 (0.47, 0.88), p=0.006	-0.4455
Current medication: Class II antiarrhythmics*	2281 (76)	0.64 (0.46, 0.90), p=0.01	-0.4397
History of cardiomyopathy*	871 (29)	0.64 (0.44, 0.93), p=0.019	-0.4509
Binary indicator CCI >= 2*	1309 (44)	0.62 (0.40, 0.95), p=0.029	-0.4841

History of other substance misuse	37 (1)	0.55 (0.14, 2.09), p=0.377	-0.6051
History of congenital heart disease*	40 (1)	0.29 (0.09, 0.92), p=0.035	-1.2241
Tachyarrhythmia description: No tachyarrhythmia*	639 (21)	0.09 (0.05, 0.18), p<0.001	-2.375
History of mild liver disease*	19 (1)	0.06 (0.00, 0.83), p=0.036	-2.8633

Legend. Table presenting the strength of association between specific administrative and registry variables and ICD indication in the CDR study interval. CI, confidence interval, * indicates p<0.05, VF, ventricular fibrillation; VT, ventricular tachycardia; ARVD, arrhythmogenic right ventricular dysplasia; MSP, Medical Services Plan; MI, myocardial infarction; ACE, angiotensin-converting enzyme; CI, confidence interval; ACEi, angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker; MRA, Mineralocorticoid receptor antagonist CCI, Charlson comorbidity index.

Supplemental Table S8: Combined registry and administrative health data variables predictive of secondary prevention ICDs in HEARTis

Variable	ICD implantations with feature, count (%)	Odds ratio (95%CI), p-value	Estimate
Intercept	2928 (100)	0.37 (0.12, 1.08), p=0.07	-1.0035
History of cardiac arrest, VF, or Brugada syndrome	475 (16)	333792441.82 (0.00, Inf), p=0.959	19.626
Implantation 'urgent/emergency' instead of 'elective'*	1445 (49)	4.45 (2.78, 7.11), p<0.001	1.4925
History of VT*	850 (29)	3.92 (2.78, 5.53), p<0.001	1.3663
Current medication: Type I or Type III antiarrhythmics*	497 (17)	2.78 (1.76, 4.40), p<0.001	1.0229
Left ventricle ejection fraction >= 35 (ref: missing)*	811 (28)	2.58 (1.65, 4.04), p<0.001	0.9496
History of channelopathy	57 (2)	2.44 (0.70, 8.56), p=0.163	0.8927
Index length of stay 3 or more days*	1437 (49)	1.62 (1.02, 2.57), p=0.039	0.4843
Hospitalization for myocardial infarction within 6 weeks of index	158 (5)	1.61 (0.73, 3.57), p=0.24	0.4777
History of syncope*	636 (22)	1.60 (1.12, 2.29), p=0.01	0.4712
Dual chamber ICD (ref: single chamber)*	1155 (39)	1.53 (1.04, 2.26), p=0.031	0.4270
Left ventricle ejection fraction <= 34 (ref: missing)	1214 (41)	1.47 (0.96, 2.25), p=0.074	0.3870
NYHA Class IV (ref: missing)	35 (1)	1.46 (0.52, 4.14), p=0.472	0.3815
History of coronary artery disease	668 (23)	1.29 (0.86, 1.93), p=0.219	0.2544
NYHA Class I (ref: missing)	465 (16)	1.08 (0.67, 1.73), p=0.752	0.0761
Neighbourhood income quintile (ordinal, 1 low 5 high)	Non-binary variable	1.04 (0.93, 1.17), p=0.453	0.0427
Age in years*	Non-binary variable	1.02 (1.00, 1.03), p=0.027	0.0163
Number of days spent in hospital year prior to index	Non-binary variable	1.00 (0.99, 1.01), p=0.544	-0.0033
Male sex	2324 (79)	0.97 (0.65, 1.45), p=0.886	-0.0294
NYHA Class III (ref: missing)	302 (10)	0.90 (0.52, 1.55), p=0.691	-0.1108
NYHA Class II (ref: missing)	703 (24)	0.85 (0.56, 1.28), p=0.431	-0.1668
History of atrial tachycardia	982 (34)	0.61 (0.41, 0.91), p=0.015	-0.4907
CRT ICD (ref: single chamber)*	900 (31)	0.55 (0.34, 0.86), p=0.01	-0.6050
Over 52 MSP visits in year prior to index (ref: 12 or less)	629 (21)	0.47 (0.22, 1.01), p=0.054	-0.7469
Between 13 and 52 MSP visits in year prior to index (ref: 12 or less)*	2058 (70)	0.36 (0.20, 0.65), p=0.001	-1.0177
Implantation 'elective' instead of 'urgent'/'emergency'*	1747 (60)	0.13 (0.09, 0.18), p<0.001	-2.0692
Comorbidities at index			
Syncope	38 (1)	1.60 (0.62, 4.12), p=0.33	0.4700
Chronic ischemic heart disease	441 (15)	1.36 (0.75, 2.45), p=0.311	0.3051
Myocardial infarction	69 (2)	0.47 (0.17, 1.33), p=0.156	-0.7489
Atrial fibrillation and flutter*	110 (4)	0.27 (0.11, 0.63), p=0.002	-1.3215
Congestive heart failure*	922 (31)	0.19 (0.12, 0.30), p<0.001	-1.6389
Other arrhythmias*	121 (4)	0.09 (0.05, 0.18), p<0.001	-2.3839
Comorbidities in the year prior to index			

Peptic ulcer disease*	18 (1)	6.68 (1.29, 34.56), p=0.024	1.8993
Dementia	20 (1)	6.16 (0.76, 50.30), p=0.09	1.8187
Cardiac arrest*	606 (21)	4.58 (2.58, 8.12), p<0.001	1.5207
Pacemaker	23 (1)	3.93 (0.75, 20.58), p=0.106	1.3676
Other arrhythmias*	2271 (78)	2.29 (1.50, 3.50), p<0.001	0.8290
Alcohol misuse	65 (2)	2.23 (0.67, 7.33), p=0.189	0.7998
Paraplegia and hemiplegia	≤5	1.85 (0.13, 26.76), p=0.65	0.6175
Other substance misuse	50 (2)	1.55 (0.50, 4.79), p=0.447	0.4373
Unstable angina	37 (1)	1.47 (0.37, 5.80), p=0.582	0.3854
Hypertension	1061 (36)	1.35 (0.95, 1.93), p=0.096	0.3031
Binary indicator CCI ≥ 2	1329 (45)	1.24 (0.74, 2.07), p=0.412	0.2148
Diabetes with complications	598 (20)	1.21 (0.69, 2.12), p=0.497	0.1933
Peripheral vascular disease	121 (4)	1.14 (0.52, 2.49), p=0.741	0.1314
Obstructive sleep apnea and other sleep disorders	90 (3)	1.14 (0.44, 2.96), p=0.79	0.1297
Myocardial infarction	681 (23)	1.07 (0.65, 1.75), p=0.801	0.0639
Chronic obstructive pulmonary disease	332 (11)	0.99 (0.59, 1.68), p=0.984	-0.0054
Chronic ischemic heart disease	1415 (48)	0.85 (0.59, 1.23), p=0.401	-0.1575
Psychiatric disorders	380 (13)	0.83 (0.51, 1.36), p=0.46	-0.1866
Renal disease	371 (13)	0.60 (0.34, 1.05), p=0.073	-0.5139
Seizure	33 (1)	0.57 (0.11, 3.02), p=0.508	-0.5634
Cancer	114 (4)	0.56 (0.22, 1.42), p=0.225	-0.5713
Heart failure*	2375 (81)	0.55 (0.34, 0.89), p=0.014	-0.6033
Cerebrovascular disease	130 (4)	0.55 (0.26, 1.15), p=0.109	-0.6064
Rheumatic disease	25 (1)	0.53 (0.08, 3.41), p=0.505	-0.6322
Diabetes without complications*	170 (6)	0.46 (0.24, 0.91), p=0.025	-0.7711
Mild liver disease	39 (1)	0.45 (0.11, 1.84), p=0.266	-0.7990
Medications active at index date			
Hydralazine	46 (2)	1.69 (0.34, 8.50), p=0.525	0.5243
ACEi or ARB	1631 (56)	1.42 (0.89, 2.24), p=0.14	0.3474
Anticoagulants	650 (22)	1.16 (0.71, 1.89), p=0.558	0.1463
Oral hypoglycemics	504 (17)	1.06 (0.62, 1.82), p=0.831	0.0587
Calcium channel blockers	229 (8)	1.06 (0.56, 2.02), p=0.862	0.0574
Number of active medications (continuous)	Non-binary variable	1.03 (0.94, 1.13), p=0.565	0.0278
Antihypertensives	2116 (72)	0.99 (0.54, 1.81), p=0.968	-0.0125
Beta blockers	1688 (58)	0.96 (0.60, 1.55), p=0.878	-0.0372
Insulin	150 (5)	0.90 (0.39, 2.04), p=0.794	-0.1098
Anti-platelets	542 (19)	0.82 (0.49, 1.40), p=0.472	-0.1937
Statins	1376 (47)	0.81 (0.53, 1.24), p=0.327	-0.2141
Benzodiazepines	243 (8)	0.81 (0.44, 1.48), p=0.492	-0.2101
Anti-arrhythmics	123 (4)	0.63 (0.29, 1.35), p=0.232	-0.4650
Nitroglycerin	180 (6)	0.60 (0.29, 1.23), p=0.162	-0.5118
MRA*	830 (28)	0.58 (0.38, 0.91), p=0.017	-0.5367
Opioids	201 (7)	0.56 (0.27, 1.14), p=0.111	-0.5821
Digoxin	143 (5)	0.55 (0.24, 1.24), p=0.148	-0.6018
Loop diuretics*	821 (28)	0.54 (0.34, 0.84), p=0.006	-0.6213

Legend. Table presenting the strength of association between specific administrative and registry variables with ICD indication in the HEARTis study interval. CI, confidence interval, * indicates p<0.05, VF, ventricular fibrillation; VT, ventricular tachycardia; NYHA, New York Heart Association; MSP, Medical Services Plan; CCI, Charlson comorbidity index; ACE, angiotensin-

converting enzyme; ACEi, angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker; MRA, Mineralocorticoid receptor antagonist.

Supplemental Table S9: Performance of rule-based ICD prediction methods

Measure of predictive model performance	CDR (2004-2012)	HEARTis (2013-2019)	All data (2004-2019)
Sensitivity	64%	85%	74%
Specificity	73%	84%	78%

Legend. Performance metrics for a simplified model based on methods from a Danish nationwide assessment of ICD use.² These models used our cardiac device registry data and distinguish ICD indication with the following rules: secondary prevention ICD if patient has an ICD code for cardiac arrest or ventricular tachycardia/fibrillation at index or in year prior to index, otherwise an ICD was considered to be for primary prevention.

Supplemental Table S10: STROBE checklist

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1, 3
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4,5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	6-8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	6,7
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	N/A
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7,8 Supplemental Tables S2-S3
Data sources/measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7,8, Supplemental Table S1 & S3
Bias	9	Describe any efforts to address potential sources of bias	8
Study size	10	Explain how the study size was arrived at	6,7, Fig. 1
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7,8, Supplemental Tables S2-S3
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	7,8
		(b) Describe any methods used to examine subgroups and interactions	N/A
		(c) Explain how missing data were addressed	7,8
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	N/A
		(e) Describe any sensitivity analyses	Supplemental Tables S6-S8

Supplemental Table S10: STROBE checklist (continued)

Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9, Fig. 1
		(b) Give reasons for non-participation at each stage	Fig. 1
		(c) Consider use of a flow diagram	Fig.1
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9, Table 1
		(b) Indicate number of participants with missing data for each variable of interest	Fig. 2
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	N/A
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	8,9, Fig. 2
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	N/A
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	N/A
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9-10, Table 2, Supplemental Tables S4-S8
		(b) Report category boundaries when continuous variables were categorized	N/A
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	10, Supplemental Tables S4-S8
Discussion			
Key results	18	Summarise key results with reference to study objectives	11
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	14
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14
Generalisability	21	Discuss the generalisability (external validity) of the study results	11-13
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	1

References

¹ Quan H, Sundararajan V, Halfon P, Fong A, Burnand B, Luthi JC, Saunders LD, Beck CA, Feasby TE, Ghali WA. Coding algorithms for defining comorbidities in ICD-9-CM and ICD-10 administrative data. *Med Care*. 2005 Nov;43(11):1130-9. doi: 10.1097/01.mlr.0000182534.19832.83. PMID: 16224307.

² Schmidt M, Pedersen SB, Farkas DK, Hjortshøj SP, Bøtker HE, Nielsen JC, Sørensen HT. Thirteen-year nationwide trends in use of implantable cardioverter-defibrillators and subsequent long-term survival. *Heart Rhythm*. 2015 Sep;12(9):2018-27. doi: 10.1016/j.hrthm.2015.04.040. Epub 2015 Apr 30. PMID: 25937527.