**APPENDIX A. SUPPLEMENTARY TABLES**

**Table A1**. Grouping of chronic conditions. Modified Magnan criteria

|  |  |
| --- | --- |
| **CCS** | **Names of Chronic Condition Categories (Magnan modified)** |
| 100 | Acute myocardial infarction |
| 92;93;94;124;126;134;253 | Allergy, ENT and other upper resp disorders |
| 59;62;64 | Anemia and other non-cancer heme disorders |
| 115 | Aneurysm |
| 651 | Anxiety disorders |
| 128 | Asthma  |
| 205 | Back problem |
| 652;654;655;656 | Behavior disorders |
| 47 | Benign neoplasm |
| 164 | Benign prostatic hypertrophy (BPH) |
| 167 | Breast non-cancer |
| 97;104 | Cardiomyopathy and Structural Heart Disease |
| 109;110;111;112;113 | Cerebrovascular Disease |
| 6 | Chronic Hepatitis |
| 8;252 | Chronic Infectious and Parasitic Diseases |
| 151 | Chronic Liver Disease (excluding chronic hepatitis) |
| 127 | Chronic obstructive pulmonary disease and bronchiectasis |
| 152 | Chronic pancreatitis |
| 157;158 | Chronic renal failure |
| 198;199;200 | Chronic skin ulcer |
| 105;106;107 | Conduction disorder or cardiac dysrhythmia |
| 213 | Congenital Heart Disease |
| 108 | Congestive heart failure |
| 101 | Coronary atherosclerosis |
| 56 | Cystic fibrosis |
| 86;87;88;89;90;91 | Degenerative eye problem (glauc/eye) |
| 136 | dental and mouth |
| 49;50 | Diabetes mellitus |
| 144;146;149;154;155 | Diverticulosis, diverticulitis, enterocolitis, intestinal malabsorption |
| 83 | Epilepsy |
| 138;139;140;141;153 | Esophageal disorder and GI ulcers |
| 168;169;170;171;175;181;183;186 | Female infertitlity and GU anatomic disorders (eg prolapse, endometriosis) |
| 54 | Gout or other crystal arthropathy |
| 96 | Heart valve disorder |
| 5 | Human immunodeficiency virus |
| 53 | Hyperlipidemia |
| 98;99 | Hypertension |
| 57;63 | Immunity disorder |
| 156;159;161;162;163 | Kidney and Vesicoureteral Disorders (excluding renal failure) |
| 210 | Lupus |
| 165;166 | Male GU excluding BPH |
| 11 to 44 | Malignant neoplasm |
| 52;58 | Malnutrition-obesity-includes disorders of metabolism |
| 173 | Menopause and perimenoapuse |
| 84 | Migraines |
| 670 | Miscellaneous mental disorders |
| 650;657 | Mood disorders (bipolar an depressive disorders) and depression |
| 80 | Multiple sclerosis |
| 214;215;216;217;224 | Non-cardiac congenital disorder |
| 117;121 | Non-thrombotic, non-athlerosclerotic vascular disease |
| 653 | Organic brain problem (dementia) |
| 203;204 | Osteoarthritis |
| 77;78;81;85;95;227 | Other central and peripheral nervous system disorders |
| 122;130;131;132;133 | Other chronic lung disease |
| 48;51;174 | Other endocrine |
| 201;206;208;209;211;212;225;236 | Other musculoskeletal including osteoporosis |
| 82 | Paralysis |
| 79 | Parkinson's disease |
| 114;247;248 | Peripheral atherosclerosis |
| 658 | Personality disorder |
| 103 | Pulmonary heart disease |
| 259 | Residual codes; unclassified |
| 202 | Rheumatoid arthritis |
| 659 | Schizophrenia and Psychotic Disorders |
| 663 | Screening and history of mental health and substance abuse |
| 61 | Sickle cell anemia |
| 7;9 | STI |
| 660;661 | Substance-use Disorders |
| 116;118 | Thrombosis and Embolism |
| 1 | Tuberculosis |

**Table A2**. The fifteen most prevalent chronic diseases at time of index discharge (N=15,109)

|  |  |  |
| --- | --- | --- |
| **Chronic disease categories (Magnan; see Table A1)** | **N**  | **%** |
| Hypertension | 12355 | 81.8% |
| Conduction disorder or cardiac dysrhythmia | 10333 | 68.4% |
| Hyperlipidemia | 7199 | 47.6% |
| Heart valve disorder | 5891 | 39.0% |
| Diabetes mellitus | 5723 | 37.9% |
| Coronary atherosclerosis | 4302 | 28.5% |
| Chronic renal failure | 4235 | 28.0% |
| Degenerative eye problem (glauc/eye) | 3955 | 26.2% |
| Cardiomyopathy and Structural Heart Disease | 3434 | 22.7% |
| Osteoarthritis | 3274 | 21.7% |
| Other musculoskeletal including osteoporosis | 3286 | 21.7% |
| Pulmonary heart disease | 3265 | 21.6% |
| Chronic obstructive pulmonary disease and bronchiectasis | 3231 | 21.4% |
| Malnutrition-obesity-includes disorders of metabolism | 3092 | 20.5% |
| Cerebrovascular Disease | 2615 | 17.3% |

**Table A3**. Baseline characteristics (age and Charlson index) at time of first discharge after admission for heart failure by year

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **2011** | **2012** | **2013** | **2014** | **2015** | p-trend\* |
| **Age at discharge**, mean ± SD | 79.4 ± 10.4 | 80 ± 10 | 80.1 ± 10.2 | 80.3 ± 10 | 80.8 ± 9.9 | 1.83E-07 |
| Died during hospitalization | 83.8 ± 9.3 | 85.1 ± 8.7 | 84.5 ± 8.4 | 84.5 ± 9.7 | 86.1 ± 7.9 | 0.0294 |
| **Alive at discharge** | **79.1 ± 10.4** | **79.6 ± 9.9** | **79.7 ± 10.3** | **80,0 ± 10** | **80.4 ± 9.9** | **6.56E-07** |
| Men | 76.7 ± 10.9 | 77.4 ± 10.5 | 77.4 ± 10.9 | 77.7 ± 10.3 | 78.2 ± 10.4 | 5.35E-05 |
| Women | 82.1 ± 9.2 | 82.4 ± 8.8 | 82.7 ± 8.8 | 82.7 ± 9,0 | 83.2 ± 8.7 | 5.42E-04 |
| **Overall Charlson Index,** mean ± SD | 3 ± 2 | 3.1 ± 1.9 | 3.1 ± 2 | 3.2 ± 2.1 | 3.3 ± 2.1 | 2.89E-07 |
| Died during hospitalization | 3.7 ± 2.4 | 3.5 ± 2.2 | 4 ± 2.7 | 4 ± 2.6 | 3.9 ± 2.4 | 0.0377 |
| **Alive at discharge** | **3,0 ± 1.9** | **3.1 ± 1.9** | **3.1 ± 2** | **3.1 ± 2** | **3.2 ± 2** | **1.62E-06** |
| Men | 3.3 ± 2.1 | 3.5 ± 2.1 | 3.5 ± 2.2 | 3.6 ± 2.2 | 3.7 ± 2.2 | 7.70E-05 |
| Women | 2.7 ± 1.8 | 2.7 ± 1.7 | 2.7 ± 1.7 | 2.8 ± 1.8 | 2.9 ± 1.8 | 4.87E-04 |

\*Linear model with age as the dependant variable and year (numerical) as the independent variable. (N = 16272 patients).

p-trend: a summary statistic for trends over time. P-trend was calculated including calendar year as a continuous variable in the models

**Table A4.** Incidence of heart failure. Statistics of variation

|  |  |  |
| --- | --- | --- |
|  | **Women** | **Men** |
| **2011** | **2012** | **2013** | **2014** | **2015** | **2011** | **2012** | **2013** | **2014** | **2015** |
| Rates (Overall) | Incidence, crude rate, per 1000 | 2.51 | 2.73 | 2.56 | 2.61 | 2.9 | 2.86 | 2.88 | 2.84 | 2.96 | 3.13 |
| Incidence, standardized rate, per 1000 | 2.26 | 2.42 | 2.23 | 2.23 | 2.45 | 3.64 | 3.66 | 3.54 | 3.63 | 3.8 |
| Statistics of variation | Max. standardized rate | 2.81 | 2.72 | 2.40 | 2.71 | 3.01 | 4.20 | 4.30 | 4.08 | 4.31 | 4.26 |
| Min. standardized rate | 1.77 | 2.04 | 1.20 | 1.39 | 1.88 | 3.00 | 2.39 | 1.96 | 2.17 | 2.86 |
| Variation Ratio | 1.59 | 1.34 | 1.99 | 1.95 | 1.60 | 1.40 | 1.80 | 2.09 | 1.99 | 1.49 |
| Systematic component of variation | 0.06 | 0.04 | 0.09 | 0.08 | 0.04 | 0.05 | 0.07 | 0.06 | 0.05 | 0.07 |

**Table A5**. Classification of unplanned hospitalizations after index discharge by primary diagnosis

|  |  |  |  |
| --- | --- | --- | --- |
| **Hospitalizations within 30 days after discharge** |  |  |  |
| Hospitalizations for heart failure | Potentially avoidable |
| **Primary diagnosis (CCS)** | **Total** | **Men** | **Women** | **Total** | **Men** | **Women** |
| Heart failure | 936 (100%) | 467 (100%) |  469 (100%) |  418 (45%) |  163 (35%) |  255 (54%) |
| Hospitalizations for Cardiovascular reasons (other than heart failure) | Potentially avoidable |
| **Primary diagnosis (CCS)** | **Total** | **Men** | **Women** | **Total** | **Men** | **Women** |
| Cardiac dysrhythmias | 110 (28.2%) | 44 (22.1%) | 66 (34.6%) | - | - | - |
| Coronary atherosclerosis and other heart disease | 52 (13.3%) | 36 (18.1%) | 16 (8.4%) | 52 (100%) | 36 (100%) | 16 (100%) |
| Acute cerebrovascular disease | 51 (13.1%) | 26 (13.1%) | 25 (13.1%) | 3 (5.9%) | 3 (11.5%) | 0 (0%) |
| Acute myocardial infarction | 30 (7.7%) | 16 (8%) | 14 (7.3%) | 30 (100%) | 16 (100%) | 14 (100%) |
| Heart valve disorders | 28 (7.2%) | 14 (7%) | 14 (7.3%) | - | - | - |
| Hypertension with complications and secondary hypertension | 15 (3.8%) | 6 (3%) | 9 (4.7%) | 9 (60%) | 5 (83.3%) | 4 (44.4%) |
| Other diagnosis | 104 (26.7%) | 57 (28.6%) | 47 (24.6%) | - | - | - |
|  |  |  |  |  |  |  |
| **Total** | **390 (100%)** | **199 (100%)** | **191 (100%)** | **94 (24.1%)** | **60 (30.2%)** | **34 (17.8%)** |
| Hospitalizations for other reasons  | Potentially avoidable |
| **Primary diagnosis (CCS)** | **Total** | **Men** | **Women** | **Total** | **Men** | **Women** |
| Chronic obstructive pulmonary disease and bronchiectasis | 101 (7.9%) | 80 (12.1%) | 21 (3.4%) | 101 (100%) | 80 (100%) | 21 (100%) |
| Other lower respiratory disease | 99 (7.8%) | 55 (8.3%) | 44 (7.2%) | 9 (9.1%) | 6 (10.9%) | 3 (6.8%) |
| Respiratory failure; insufficiency; arrest (adult) | 81 (6.4%) | 37 (5.6%) | 44 (7.2%) | - | - | - |
| Pneumonia (except that caused by TB or STD) | 73 (5.7%) | 41 (6.2%) | 32 (5.2%) | 67 (91.8%) | 36 (87.8%) | 31 (96.9%) |
| Acute and unspecified renal failure | 68 (5.3%) | 34 (5.1%) | 34 (5.5%) | - | - | - |
| Urinary tract infections | 62 (4.9%) | 18 (2.7%) | 44 (7.2%) | 62 (100%) | 18 (100%) | 44 (100%) |
| Other diagnosis | 798 (62.2%) | 398 (60%) | 400 (64.6%) | 135 (16.9%) | 42 (10.6%) | 93 (23.3%) |
| **Total** | **1282 (100%)** | **663 (100%)** | **619 (100%)** | **374 (29.2%)** | **182 (27.5%)** | - |
|  |  |  |  |  |  |  |
| **Hospitalizations within 365 days after discharge** |  |  |  |
| Hospitalizations for heart failure | Potentially avoidable |
| **Primary diagnosis (CCS)** | **Total** | **Men** | **Women** | **Total** | **Men** | **Women** |
| Heart failure | 4700 (100%) | 2369 (100%) |  2331 (100%) | 1992 (42.4%)  | 741 (31.3%) | 1251 (53.7) |
| Hospitalizations for Cardiovascular reasons (other than heart failure) | Potentially avoidable |
| **Primary diagnosis (CCS)** | **Total** | **Men** | **Women** | **Total** | **Men** | **Women** |
| Cardiac dysrhythmias | 512 (26.3%) | 236 (23%) | 276 (30.1%) | - | - | - |
| Acute cerebrovascular disease | 257 (13.2%) | 131 (12.8%) | 126 (13.7%) | 24 (9.3%) | 16 (12.2%) | 8 (6.3%) |
| Coronary atherosclerosis and other heart disease | 247 (12.7%) | 158 (15.4%) | 89 (9.7%) | 247 (100%) | 158 (100%) | 89 (100%) |
| Acute myocardial infarction | 166 (8.5%) | 86 (8.4%) | 80 (8.7%) | 166 (100%) | 86 (100%) | 80 (100%) |
| Heart valve disorders | 108 (5.6%) | 55 (5.4%) | 53 (5.8%) | - | - | - |
| Peri-; endo-; and myocarditis; cardiomyopathy (except that caused by TB or STD) | 84 (4.3%) | 55 (5.4%) | 29 (3.2%) | - | - | - |
| Peripheral and visceral atherosclerosis | 82 (4.2%) | 51 (5%) | 31 (3.4%) | - | - | - |
| Other diagnosis | 489 (25.1%) | 255 (24.8%) | 234 (25.5%) | 52 (10.6%) | 28 (11%) | 24 (10.3%) |
| **Total** | **1945 (100%)** | **1027 (100%)** | **918 (100%)** | **489 (25.1%)** | **288 (28%)** | **201 (21.9%)** |
| Hospitalizations for other reasons  | Potentially avoidable |
| **Primary diagnosis (CCS)** | **Total** | **Men** | **Women** | **Total** | **Men** | **Women** |
| Chronic obstructive pulmonary disease and bronchiectasis | 751 (9.5%) | 619 (14.7%) | 132 (3.6%) | 751 (100%) | 619 (100%) | 132 (100%) |
| Other lower respiratory disease | 663 (8.4%) | 311 (7.4%) | 352 (9.6%) | 60 (9%) | 30 (9.6%) | 30 (8.5%) |
| Pneumonia (except that caused by TB or STD) | 554 (7%) | 306 (7.3%) | 248 (6.8%) | 535 (96.6%) | 294 (96.1%) | 241 (97.2%) |
| Respiratory failure; insufficiency; arrest (adult) | 496 (6.3%) | 242 (5.8%) | 254 (6.9%) | - | - | - |
| Acute bronchitis | 380 (4.8%) | 124 (3%) | 256 (7%) | 380 (100%) | 124 (100%) | 256 (100%) |
| Urinary tract infections | 312 (4%) | 117 (2.8%) | 195 (5.3%) | 308 (98.7%) | 115 (98.3%) | 193 (99%) |
| Acute and unspecified renal failure | 260 (3.3%) | 139 (3.3%) | 121 (3.3%) | - | - | - |
| Other diagnosis | 4498 (56.8%) | 2367 (56%) | 2131 (57.8%) | 573 (12.7%) | 220 (9.3%) | 353 (16 |
| **Total** | **7914 (100%)** | **4225 (100%)** | **3689 (100%)** | **2607 (32.9%)** | **1402 (33.2%)** | **1205 (32.7%)** |

**Table A6.** Trends in event rates after index discharge by year.

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | **Men** | **Women** |
|  |  | **OR (IC 95%)** | **OR (IC 95%)** |
|  |  | **2011** | **2012** | **2013** | **2014** | **2015** | **p-trend** | **2011** | **2012** | **2013** | **2014** | **2015** | **p-trend** |
| **Mortality** | ≤30 days | 1 (ref.) | 0.75 (0.51, 1.09) | 0.99 (0.7, 1.4) | 1.06 (0.75, 1.49) | 0.71 (0.49, 1.02) | 0.396 | 1 (ref.) | 0.79 (0.57, 1.1) | 0.82 (0.59, 1.14) | 0.69 (0.49, 0.97) | 0.92 (0.67, 1.25) | 0.505 |
| ≤365 days | 1 (ref.) | 0.79 (0.66, 0.95) | 0.82 (0.68, 0.98) | 0.9 (0.76, 1.07) | 0.8 (0.67, 0.95) | 0.106 | 1 (ref.) | 0.81 (0.68, 0.97) | 0.93 (0.78, 1.1) | 0.88 (0.74, 1.05) | 0.84 (0.7, 0.99) | 0.174 |
| **Unplanned hospitalizations ≤ 30 days** | Any cause | 1 (ref.) | 0.91 (0.76, 1.08) | 0.92 (0.78, 1.1) | 0.94 (0.79, 1.11) | 0.88 (0.75, 1.05) | 0.281 | 1 (ref.) | 1.08 (0.9, 1.28) | 0.98 (0.81, 1.17) | 1.01 (0.85, 1.21) | 1.02 (0.86, 1.22) | 0.898 |
| Main cause HF | 1 (ref.) | 0.97 (0.72, 1.31) | 0.98 (0.72, 1.33) | 0.92 (0.68, 1.25) | 0.91 (0.67, 1.22) | 0.462 | 1 (ref.) | 1.16 (0.87, 1.56) | 0.9 (0.66, 1.24) | 1.16 (0.86, 1.56) | 1.15 (0.86, 1.54) | 0.408 |
| HF Potentially avoidable | 1 (ref.) | 1.06 (0.66, 1.71) | 0.99 (0.61, 1.61) | 0.72 (0.42, 1.21) | 0.87 (0.53, 1.43) | 0.261 | 1 (ref.) | 1.01 (0.69, 1.47) | 0.66 (0.43, 1) | 0.85 (0.57, 1.27) | 0.99 (0.69, 1.44) | 0.745 |
| **Unplanned hospitalizations ≤ 365 days** | Any cause | 1 (ref.) | 0.95 (0.85, 1.06) | 0.93 (0.83, 1.04) | 0.93 (0.84, 1.04) | 0.9 (0.81, 1) | 0.058 | 1 (ref.) | 0.91 (0.82, 1.02) | 0.96 (0.86, 1.07) | 0.97 (0.87, 1.08) | 0.88 (0.79, 0.98) | 0.117 |
| Main cause HF | 1 (ref.) | 1 (0.83, 1.19) | 1 (0.83, 1.19) | 0.88 (0.73, 1.05) | 0.92 (0.77, 1.1) | 0.124 | 1 (ref.) | 0.88 (0.73, 1.05) | 0.93 (0.77, 1.11) | 0.93 (0.78, 1.11) | 0.83 (0.7, 0.99) | 0.109 |
| HF Potentially avoidable | 1 (ref.) | 1.01 (0.77, 1.33) | 1.02 (0.78, 1.34) | 0.76 (0.57, 1.01) | 0.91 (0.7, 1.19) | 0.132 | 1 (ref.) | 0.85 (0.69, 1.06) | 0.77 (0.61, 0.96) | 0.84 (0.67, 1.04) | 0.73 (0.59, 0.91) | 0.009 |

HF: Heart failure

OR: Odds Ratios adjusted for age and level of comorbidity (Charlson index)

Ref.: reference category

p-trend: a summary statistic for trends over time. P-trend was calculated including calendar year as a continuous variable in the models

APPENDIX B. SUPLEMENTARY FIGURES

Figure B1. Overall survival curve and hazard function following the first discharge after admission for heart failure.

(a) First 4 years

(b) First 30 days