

**Appendix A: The ICD-10 codes used to generate the Hospital Frailty Risk Score (HFRS)**

<b>ICD-10 Code</b>	<b>Diagnosis</b>	<b>Points Awarded</b>
<b>F00</b>	Dementia in Alzheimer's disease	7·1
<b>G81</b>	Hemiplegia	4·4
<b>G30</b>	Alzheimer's disease	4·0
<b>I69</b>	Sequelae of cerebrovascular disease (secondary codes)	3·7
<b>R29</b>	Other symptoms and signs involving the nervous and musculoskeletal systems (R29·6 Tendency to fall)	3·6
<b>N39</b>	Other disorders of urinary system (includes urinary tract infection and urinary incontinence)	3·2
<b>F05</b>	Delirium, not induced by alcohol and other psychoactive substances	3·2
<b>W19</b>	Unspecified fall	3·2
<b>S00</b>	Superficial injury of head	3·2
<b>R31</b>	Unspecified haematuria	3·0
<b>B96</b>	Other bacterial agents as the cause of diseases classified to other chapters (secondary code)	2·9
<b>R41</b>	Other symptoms and signs involving cognitive functions and awareness	2·7
<b>R26</b>	Abnormalities of gait and mobility	2·6
<b>I67</b>	Other cerebrovascular diseases	2·6
<b>R56</b>	Convulsions, not elsewhere classified	2·6
<b>R40</b>	Somnolence, stupor and coma	2·5
<b>T83</b>	Complications of genitourinary prosthetic devices, implants and grafts	2·4
<b>S06</b>	Intracranial injury	2·4
<b>S42</b>	Fracture of shoulder and upper arm	2·3
<b>E87</b>	Other disorders of fluid, electrolyte and acid-base balance	2·3
<b>M25</b>	Other joint disorders, not elsewhere classified	2·3

<b>E86</b>	Volume depletion	2·3
<b>R54</b>	Senility	2·2
<b>Z50</b>	Care involving use of rehabilitation procedures	2·1
<b>F03</b>	Unspecified dementia	2·1
<b>W18</b>	Other fall on same level	2·1
<b>Z75</b>	Problems related to medical facilities and other health care	2·0
<b>F01</b>	Vascular dementia	2·0
<b>S80</b>	Superficial injury of lower leg	2·0
<b>L03</b>	Cellulitis	2·0
<b>H54</b>	Blindness and low vision	1·9
<b>E53</b>	Deficiency of other B group vitamins	1·9
<b>Z60</b>	Problems related to social environment	1·8
<b>G20</b>	Parkinson's disease	1·8
<b>R55</b>	Syncope and collapse	1·8
<b>S22</b>	Fracture of rib(s), sternum and thoracic spine	1·8
<b>K59</b>	Other functional intestinal disorders	1·8
<b>N17</b>	Acute renal failure	1·8
<b>L89</b>	Decubitus ulcer	1·7
<b>Z22</b>	Carrier of infectious disease	1·7
<b>B95</b>	Streptococcus and staphylococcus as the cause of diseases classified to other chapters	1·7
<b>L97</b>	Ulcer of lower limb, not elsewhere classified	1·6
<b>R44</b>	Other symptoms and signs involving general sensations and perceptions	1·6
<b>K26</b>	Duodenal ulcer	1·6
<b>I95</b>	Hypotension	1·6
<b>N19</b>	Unspecified renal failure	1·6

<b>A41</b>	Other septicaemia	1·6
<b>Z87</b>	Personal history of other diseases and conditions	1·5
<b>J96</b>	Respiratory failure, not elsewhere classified	1·5
<b>X59</b>	Exposure to unspecified factor	1·5
<b>M19</b>	Other arthrosis	1·5
<b>G40</b>	Epilepsy	1·5
<b>M81</b>	Osteoporosis without pathological fracture	1·4
<b>S72</b>	Fracture of femur	1·4
<b>S32</b>	Fracture of lumbar spine and pelvis	1·4
<b>E16</b>	Other disorders of pancreatic internal secretion	1·4
<b>R94</b>	Abnormal results of function studies	1·4
<b>N18</b>	Chronic renal failure	1·4
<b>R33</b>	Retention of urine	1·3
<b>R69</b>	Unknown and unspecified causes of morbidity	1·3
<b>N28</b>	Other disorders of kidney and ureter, not elsewhere classified	1·3
<b>R32</b>	Unspecified urinary incontinence	1·2
<b>G31</b>	Other degenerative diseases of nervous system, not elsewhere classified	1·2
<b>Y95</b>	Nosocomial condition	1·2
<b>S09</b>	Other and unspecified injuries of head	1·2
<b>R45</b>	Symptoms and signs involving emotional state	1·2
<b>G45</b>	Transient cerebral ischaemic attacks and related syndromes	1·2
<b>Z74</b>	Problems related to care-provider dependency	1·1
<b>M79</b>	Other soft tissue disorders, not elsewhere classified	1·1
<b>W06</b>	Fall involving bed	1·1
<b>S01</b>	Open wound of head	1·1

<b>A04</b>	Other bacterial intestinal infections	1·1
<b>A09</b>	Diarrhoea and gastroenteritis of presumed infectious origin	1·1
<b>J18</b>	Pneumonia, organism unspecified	1·1
<b>J69</b>	Pneumonitis due to solids and liquids	1·0
<b>R47</b>	Speech disturbances, not elsewhere classified	1·0
<b>E55</b>	Vitamin D deficiency	1·0
<b>Z93</b>	Artificial opening status	1·0
<b>R02</b>	Gangrene, not elsewhere classified	1·0
<b>R63</b>	Symptoms and signs concerning food and fluid intake	0·9
<b>H91</b>	Other hearing loss	0·9
<b>W10</b>	Fall on and from stairs and steps	0·9
<b>W01</b>	Fall on same level from slipping, tripping and stumbling	0·9
<b>E05</b>	Thyrotoxicosis [hyperthyroidism]	0·9
<b>M41</b>	Scoliosis	0·9
<b>R13</b>	Dysphagia	0·8
<b>Z99</b>	Dependence on enabling machines and devices	0·8
<b>U80</b>	Agent resistant to penicillin and related antibiotics	0·8
<b>M80</b>	Osteoporosis with pathological fracture	0·8
<b>K92</b>	Other diseases of digestive system	0·8
<b>I63</b>	Cerebral Infarction	0·8
<b>N20</b>	Calculus of kidney and ureter	0·7
<b>F10</b>	Mental and behavioural disorders due to use of alcohol	0·7
<b>Y84</b>	Other medical procedures as the cause of abnormal reaction of the patient	0·7
<b>R00</b>	Abnormalities of heart beat	0·7
<b>J22</b>	Unspecified acute lower respiratory infection	0·7

<b>Z73</b>	Problems related to life-management difficulty	0·6
<b>R79</b>	Other abnormal findings of blood chemistry	0·6
<b>Z91</b>	Personal history of risk-factors, not elsewhere classified	0·5
<b>S51</b>	Open wound of forearm	0·5
<b>F32</b>	Depressive episode	0·5
<b>M48</b>	Spinal stenosis (secondary code only)	0·5
<b>E83</b>	Disorders of mineral metabolism	0·4
<b>M15</b>	Polyarthrosis	0·4
<b>D64</b>	Other anaemias	0·4
<b>L08</b>	Other local infections of skin and subcutaneous tissue	0·4
<b>R11</b>	Nausea and vomiting	0·3
<b>K52</b>	Other noninfective gastroenteritis and colitis	0·3
<b>R50</b>	Fever of unknown origin	0·1

**Appendix B: Hospital-patient One-year Mortality Risk (HOMR) scoring system.**

Variable	Value	Points	Variable	Value	Points
Sex	Female	0	ED visits in prior year	0	0
	Male	1		1+	1
Home O2 prior to admission	No	0	Admits by ambulance in prior year	0	0
	Yes	4		1	3
Diagnostic Risk Score (see Appendix C)		From Appendix C		2	4
Patient admitted directly to ICU		2		3+	5
Urgent 30-day readmission		1			
Admitting Service	General medicine	10		General surgery	8
	Cardiology	8		Cardiovascular surgery	9
	GI/Nephro/Neuro	9		Neurosurgery	10
	Palliative Care	28		Orthopedic/Plastic Surgery	7
	Hematology/Oncology	14		Thoracic / Transplant	7
	Ante-,intra-,postpartum	0		Trauma	8
	Gynecology	7		Urology	6

Variable	Level	Points						
		Charlson Score						
		0	1	2	3	4	5	6
Age	20-24.9	0	3	5	7	8	9	10
	25-29.9	2	5	7	9	10	11	11
	30-34.9	4	7	9	11	12	12	13
	35-39.9	7	9	11	12	13	14	15
	40-44.9	8	11	13	14	15	15	16
	45-49.9	10	13	14	15	16	17	17
	50-54.9	12	14	16	17	17	18	18
	55-59.9	14	16	17	18	19	19	20
	60-64.9	15	17	18	19	20	20	21
	65-69.9	17	19	20	21	21	22	22
	70-74.9	18	20	21	22	22	23	23
	75-79.9	20	21	22	23	23	24	24
	80-84.9	21	23	23	24	24	25	25
85-89.9	23	24	25	25	25	26	26	
90-94.9	24	25	26	26	26	27	27	
95+	25	26	27	27	27	28	28	

Variable	Level	Points			
		Admissions by ambulance			
		0	1	2	3+
Living Status	Independent	0	0	0	0
	Rehabilitation	3	3	2	2
	Home care	4	3	3	3
	Nursing Home	4	4	4	3

	Chronic Hospital	8	6	5	5
Admission Urgency	Elective	0	0	0	0
	ED, no ambulance	3	1	0	0
	ED, ambulance	5	2	1	0

The patients HOMR score is the sum of points assigned to each covariate. Note that points for the interacting covariates age and Charlson score include the risk of patient age, Charlson score, and the interaction of these covariates. In contrast, the points for living status and admission urgency include the risk of these covariates and their interaction with admissions by ambulance in the previous year; points for the latter covariate are considered separately at the top of the table.

**APPENDIX C: Diagnostic risk score used in HOMR**

<b>Diagnosis</b>	<b>Points</b>	<b>ICD10</b>	<b>ICD9</b>						
Cardiac arrest	12	I46	427.5						
Anoxic injury and other cerebral disorders	11	G93	331.8	348.0	348.1	348.2	348.3	348.4	348.5
					348.8	348.9			
Brain cancer	9	C71	191.0	191.1	191.2	191.3	191.4	191.5	191.6
					191.7	191.8	191.9		
Adult respiratory distress syndrome	9	J80	518.8						
Pancreatic cancer	8	C25	157.0	157.1	157.2	157.3	157.4	157.8	157.9
Shock	8	R57	785.5						
Esophageal cancer	7	C15	150.0	150.1	150.2	150.3	150.4	150.5	150.8
					150.9				
Gastric cancer	7	C16	151.0	151.3	151.4	151.2	151.1	151.5	151.6
			151.8	151.9					
Myeloid leukemias	7	C92	205.0 205.1 205.2 205.3						
Acute endocarditis	7	I33	421.0 421.9						
Diffuse parenchymal lung disease	7	J84	516.0	516.2	516.1	516.8	51.5	516.3	516.4
			516.9						
Liver cancer	6	C22	155.0 155.1 155.2						
Intestinal lesions	6	K63	569.5 569.8 211.3 569.9						
Alcoholic liver disease	6	K70	571.0 571.1 571.2 571.3						
Bronchogenic carcinoma	5	C34	162.0	162.2	162.3	162.4	162.5	162.8	162.9
Non-hodgkins lymphoma	5	C85	202.8 200.7						
Intracerebral hemorrhage	5	I61	431						
Aspiration pneumonitis	5	J69	507.0 507.1 507.8						
Respiratory failure	5	J96	518.8 518.5						
Biliary tract disease	5	K83	576.1 576.2 576.4 577.8 577.9						
Ascites	5	R18	789.5 568.8						
Septicemia	4	A41	038.0	038.1	038.3	038.4	038.8	038.9	
Metastatic cancer	4	C78	197.0	197.1	197.2	197.3	197.4	197.5	197.6
					197.7	197.8			
Metastatic cancer	4	C79	198.0	198.1	198.2	198.3	198.4	198.5	198.6
					198.7	198.8			
Hepatic failure	4	K72	570.0 572.2 572.4 572.8						
Cirrhosis	4	K74	571.5 571.6 571.9						
Bladder cancer	3	C67	188.0	188.1	188.2	188.3	188.4	188.5	188.6
					188.7	188.8	188.9		
Pleural effusion	3	J90	511.1 511.8 511.9						
Head injury and consequences	3	S06	085.0	851.0	851.1	852.0	852.1	853.0	853.1
					854.0	854.1			
Oncological treatment and aftercare	2	Z51	V07.1	V58.0	V58.1	V58.2	V58.8	V58.9	
Hip or femoral fracture	1	S72	820.0	820.1	820.2	820.3	821.0	821.1	821.2
					821.3				
Acute myocardial infarction	-1	I21	410.0	410.1	410.2	410.3	410.4	410.5	410.6
					410.7	410.8	410.9		
Unspecified dementia	-3	F03	290.1 290.2 290.4 290.8 290.9						
Delirium	-3	F05	290.3 293.0 293.8						
Atrial fibrillation or flutter	-3	I48	427.3						



Chronic obstructive pulmonary disease	-3	J44	491.0	491.1	491.2	491.8	491.9	492.8	496.0
Lumbar or pelvic fracture	-3	S32	805.4	805.5	805.6	805.7	808.0	808.1	808.2
				808.3	808.4	808.5	808.8	808.9	
Convalescence	-3	Z54	V66.0	V66.1	V66.2	V66.3	V66.4	V66.5	V66.6
						V66.9			
Breast cancer	-4	C50	174.0	174.1	174.2	174.3	174.4	174.5	174.6
						174.8	174.9		
Type .2 diabetes mellitus	-4	E11	250.0	250.1	250.2	250.3	250.4	250.5	250.6
						250.7			
Cellulitis	-4	L03	681.0	681.1	682.0	682.2	682.3	682.5	682.6
						682.8	682.9		
Abdominal pain	-4	R10				789.0			
Diarrhea, presumed infectious	-5	A09		009.0	009.1	009.2	009.3		
Prostate cancer	-5	C61				185.0			
Conduction abnormalities	-5	I44	426.0	426.1	426.2	426.3	426.4	426.5	426.6
						426.8	426.9		
Diverticular disease	-5	K57				562.0	562.1		
Rehabilitation	-5	Z50	V57.1	V57.2	V57.3	V57.4	V57.8	V57.9	
Tachycardia	-6	I47			427.0	427.1	427.2		
Osteoarthritis of the hip	-6	M16			715.1	715.2	715.3		
DM.1	-7	E10	250.0	250.1	250.2	250.3	250.4	250.5	250.6
						250.7			
Coronary heart disease	-7	I25	412.0	414.0	414.1	414.8	414.9	429.2	
Inguinal Hernia	-7	K40			550.0	550.1	550.9		
Abnormalities of heart beat	-7	R00			427.8	785.0	785.1	785.3	
Signs of neurological/MSK system	-7	R29		719.6	781.6	781.7	781.9	796.1	
Lower leg fracture	-7	S82	822.0	822.1	823.0	823.1	823.2	823.3	824.0
			824.1	824.2	824.3	824.4	824.5	824.6	824.7
						824.8	824.9	827.0	827.1
Cholelithiasis	-8	K80		574.0	574.1	574.2	574.3	574.5	
Angina	-9	I20	411.0	411.1	411.8	413.0	413.1	413.9	
Intervertebral disc disorder	-9	M51		722.1	722.3	722.5	722.7	722.9	
Syncope	-9	R55				780.2			
Spondylopathy	-10	M48	721.0	721.2	721.3	721.5	721.6	721.7	721.8
					721.9	723.0	724.0		
Hypertension	-11	I10			401.0	401.1	401.9		
Osteoarthritis of the knee	-11	M17			715.1	715.2	715.3		
Acute appendicitis	-12	K35			540.0	540.1	540.9		
Neck or Chest pain	-12	R07				784.1	786.5		
Cerebral ischemia	-13	G45			362.3	435.X	435.0	436.X	
Dizziness	-13	R42				780.4			
Asthma	-15	J45			493.0	493.1	493.2	493.9	
Vertigo	-16	H81	386.0	386.1	386.2	386.3	386.4	386.5	386.8
						386.9			
Female genital prolapse	-20	N81	618.0	618.2	618.3	618.4	618.6	618.8	618.9
Thyroid cancer	-21	C73				193.0			

Cerebral artery occlusion or stenosis	-22	I65	433.2 433.0 433.1 433.8 433.9
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**Appendix D: Summary of logistic regression models**

MODEL	VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	P-VALUE	C-STAT	LR Stat	Adequacy
<b>HOSPITALIZATION &gt; 10 DAYS</b>							
Unadjusted	Intercept	4.4037	0.0447	<0.0001	0.705	52398.1	0.894
	1/(HFRS+1)	-6.1945	0.0428	<0.0001			
	(1/(HFRS+1))*LOG(HFRS+1)	-3.1828	0.0387	<0.0001			
Unadjusted	Intercept	-7.9326	0.0899	<0.0001	0.619	18605.1	0.317
	HOMR	0.2903	0.00441	<0.0001			
	HOMR**2	-0.00274	0.000054	<0.0001			
Adjusted	Intercept	-0.2426	0.1036	0.0191	0.723	58619.07	1
	1/(HFRS+1)	-5.7095	0.0434	<0.0001			
	(1/(HFRS+1))*LOG(HFRS+1)	-2.9881	0.0391	<0.0001			
	HOMR	0.1734	0.00451	<0.0001			
	HOMR**2	-0.0016	0.000056	<0.0001			
<b>DEATH WITHIN 30 DAYS</b>							
Unadjusted	Intercept	-1.8941	0.00824	<0.0001	0.554	1550.12	0.028
	1/sqrt(HFRS+1)	-0.00007	3.64E-06	<0.0001			
	HFRS+1	0.0231	0.00109	<0.0001			
Unadjusted	Intercept	-10.3298	0.0875	<0.0001	0.772	54402.21	0.994
	HOMR**2	0.025	0.000374	<0.0001			
	HOMR**2*LOG(HOMR)	-0.00534	0.000087	<0.0001			
Adjusted	Intercept	-10.3788	0.0886	<0.0001	0.773	54751.14	1
	1/sqrt(HFRS+1)	-0.00004	3.98E-06	<0.0001			
	HFRS+1	-0.022	0.0012	<0.0001			
	HOMR**2	0.0257	0.000378	<0.0001			
	HOMR**2*LOG(HOMR)	-0.00549	0.000088	<0.0001			
<b>READMISSION WITHIN 30 DAYS</b>							
Unadjusted	Intercept	-1.8261	0.00785	<0.0001	0.524	384.16	0.193
	HFRS+1	-0.0283	1.84E-03	<0.0001			
	(HFRS+1)**3	0.00002	5.02E-06	<0.0001			
Unadjusted	Intercept	-3.198	0.0473	<0.0001	0.541	1126.48	0.565
	HOMR**2	0.00199	0.000091	<0.0001			
	HOMR**3	-0.00003	1.54E-06	<0.0001			

Adjusted	Intercept	-3.2562	0.0474	<0.0001	0.56	1995.47	1
	HFRS+1	-0.0453	1.87E-03	<0.0001			
	(HFRS+1)**3	0.000037	4.87E-06	<0.0001			
	HOMR**2	0.0023	0.000091	<0.0001			
	HOMR**3	-0.00003	1.53E-06	<0.0001			

The adequacy indicates the proportion of the log likelihood in the adjusted model that is explained by those variables. (C-stat = c-statistic; LR Stat = likelihood ratio statistic; HFRS = Hospital Frailty Risk Score; HOMR = Hospital-patient One-year Mortality Risk).

**APPENDIX E:** Competing risks model for the association of HFRS with time to readmission

Patients discharged from hospital might *not* experience a readmission because of a preceding death. In this situation, death is a competing risk for time to readmission. Censoring observation time for people who die before readmission can lead to biased parameter estimates when modelling time to readmission. To address this issue, we used Fine-Grey methods to model the time to readmission (controlling for the HFRS) while accounting for the competing risk of death. The resulting model shows that HFRS is associated with a *decreased* risk of readmission even after accounting for the competing risk of death.

<b>Parameter</b>	<b>Estimate</b>	<b>SE</b>	<b>Chi<sup>2</sup></b>	<b>P-value</b>	<b>HazardRatio</b>
HFRS	-0.020919235	0.001156561	327.1558	0.0000	0.979