

## Appendix 3: Supplementary data

### Patterns of multimorbidity in internal medicine patients in Swiss university hospitals: a multicentre cohort study

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**Table S1:** Clinical Classification Software (CCS) categories and their frequency in the total population and among patients with or without multimorbidity. Data are number with percentage. Not all 285 CCS categories were present in the sample.

CCS Category	Total population (n = 42,739)	Without multimorbidity (n = 8,868)	With multimorbidity (n=33,871)
Chronic heart disease	16,946 (39.65)	1,229 (13.86)	15,717 (46.40)
Solid malignancy	5,745 (13.44)	781 (8.81)	4,964 (14.66)
Chronic kidney disease	5,277 (12.35)	103 (1.16)	5,174 (15.28)
Substance-related disorders	4,296 (10.05)	143 (1.61)	4,153 (12.26)
COPD and bronchiectasis	3,144 (7.36)	165 (1.86)	2,979 (8.80)
Cerebrovascular disease	2,962 (6.93)	119 (1.34)	2,843 (8.39)
Other nervous system disorders	2,928 (6.85)	185 (2.09)	2,743 (8.10)
Arthropathy and arthritis	2,605 (6.10)	126 (1.42)	2,479 (7.32)
Mood disorders	2,548 (5.96)	78 (0.88)	2,470 (7.29)
Pulmonary heart disease	2,297 (5.37)	136 (1.53)	2,161 (6.38)
Haematological malignancy	2,289 (5.36)	368 (4.15)	1,921 (5.67)
Acute and unspecified renal failure	2,128 (4.98)	113 (1.27)	2,015 (5.95)
Paralysis	2,096 (4.90)	44 (0.50)	2,052 (6.06)
Peripheral and visceral atherosclerosis	2,089 (4.89)	69 (0.78)	2,020 (5.96)
Thyroid disorders	1,973 (4.62)	81 (0.91)	1,892 (5.59)
Dementia	1,794 (4.20)	43 (0.48)	1,751 (5.17)
Liver disease	1,644 (3.85)	74 (0.83)	1,570 (4.64)
Nephritis, nephrosis and renal sclerosis	1,506 (3.52)	33 (0.37)	1,473 (4.35)
Epilepsy; convulsions	1,458 (3.41)	121 (1.36)	1,337 (3.95)
Diseases of white blood cells	1,444 (3.38)	63 (0.71)	1,381 (4.08)
Anxiety disorders	1,359 (3.18)	44 (0.50)	1,315 (3.88)
Oesophageal disorders	1,313 (3.07)	41 (0.46)	1,272 (3.76)
Osteoporosis	1,216 (2.85)	13 (0.15)	1,203 (3.55)
Other hereditary and degenerative nervous system conditions	1,128 (2.64)	89 (1.00)	1,039 (3.07)

Other and ill-defined heart disease	1,082 (2.53)	8 (0.09)	1,074 (3.17)
Miscellaneous mental health disorders	980 (2.29)	48 (0.54)	932 (2.75)
Other nutritional/endocrine/metabolic disorders	872 (2.04)	34 (0.38)	838 (2.47)
Systemic lupus erythematosus and connective tissue disorders	801 (1.87)	81 (0.91)	720 (2.13)
Cardiac and circulatory congenital anomalies	781 (1.83)	117 (1.32)	664 (1.96)
Chronic ulcer of skin	721 (1.69)	20 (0.23)	701 (2.07)
Hyperplasia of prostate	678 (1.59)	12 (0.14)	666 (1.97)
Asthma	659 (1.54)	86 (0.97)	573 (1.69)
Parkinson`s disease	635 (1.49)	99 (1.12)	536 (1.58)
Aortic; peripheral; and visceral artery aneurysms	613 (1.43)	25 (0.28)	588 (1.74)
Occlusion or stenosis of precerebral arteries	609 (1.42)	12 (0.14)	597 (1.76)
Other circulatory disease	527 (1.23)	16 (0.18)	511 (1.51)
Retinal detachments; defects; vascular occlusion; and retinopathy	526 (1.23)	38 (0.43)	488 (1.44)
Immunity disorders	513 (1.20)	29 (0.33)	484 (1.43)
Diverticulosis and diverticulitis	430 (1.01)	26 (0.29)	404 (1.19)
Other lower respiratory disease	399 (0.93)	19 (0.21)	380 (1.12)
Biliary tract disease	379 (0.89)	29 (0.33)	350 (1.03)
Personality disorders	371 (0.87)	7 (0.08)	364 (1.07)
Glaucoma	339 (0.79)	86 (0.97)	253 (0.75)
Other inflammatory condition of skin	320 (0.75)	40 (0.45)	280 (0.83)
Multiple sclerosis	301 (0.70)	105 (1.18)	196 (0.58)
Other diseases of kidney and ureters	297 (0.69)	0 (0.00)	297 (0.88)
Aortic and peripheral arterial embolism or thrombosis	277 (0.65)	9 (0.10)	268 (0.79)
Psychosis and schizophrenic disorders	277 (0.65)	8 (0.09)	269 (0.79)
Regional enteritis and ulcerative colitis	262 (0.61)	55 (0.62)	207 (0.61)
Cataract	252 (0.59)	100 (1.13)	152 (0.45)
Neoplasms of unspecified nature or uncertain behaviour	251 (0.59)	9 (0.10)	242 (0.71)
Other diseases of veins and lymphatics	250 (0.58)	21 (0.24)	229 (0.68)
Gastritis and duodenitis	248 (0.58)	21 (0.24)	227 (0.67)
Other ear and sense organ disorders	235 (0.55)	7 (0.08)	228 (0.67)
HIV infection	234 (0.55)	22 (0.25)	212 (0.63)
Gastroduodenal ulcer (except haemorrhage)	231 (0.54)	6 (0.07)	225 (0.66)
Adjustment disorders	219 (0.51)	6 (0.07)	213 (0.63)
Headache; including migraine	214 (0.50)	30 (0.34)	184 (0.54)
Other eye disorders	213 (0.50)	30 (0.34)	183 (0.54)
Other diseases of bladder and urethra	210 (0.49)	2 (0.02)	208 (0.61)
Other connective tissue disease	179 (0.42)	8 (0.09)	171 (0.50)
Other congenital anomalies	177 (0.41)	15 (0.17)	162 (0.48)
Other upper respiratory infections	146 (0.34)	8 (0.09)	138 (0.41)
Other upper respiratory disease	133 (0.31)	1 (0.01)	132 (0.39)
Other bone disease and musculoskeletal deformities	122 (0.29)	4 (0.05)	118 (0.35)

Other haematological conditions	121 (0.28)	1 (0.01)	120 (0.35)
Malignant neoplasm without specification of site	120 (0.28)	3 (0.03)	117 (0.35)
Cystic fibrosis	112 (0.26)	8 (0.09)	104 (0.31)
Other acquired deformities	109 (0.26)	3 (0.03)	106 (0.31)
Other gastrointestinal disorders	105 (0.25)	6 (0.07)	99 (0.29)
Pancreatic disorders (not diabetes)	102 (0.24)	6 (0.07)	96 (0.28)
Developmental disorders	98 (0.23)	4 (0.05)	94 (0.28)
Inflammation; infection of eye (except that caused by tuberculosis or sexually transmitted disease)	87 (0.20)	37 (0.42)	50 (0.15)
Genitourinary congenital anomalies	85 (0.20)	4 (0.05)	81 (0.24)
Sickle cell anaemia	84 (0.20)	39 (0.44)	45 (0.13)
Other and unspecified benign neoplasm	78 (0.18)	5 (0.06)	73 (0.22)
Allergic reactions	70 (0.16)	11 (0.12)	59 (0.17)
Other CNS infection and poliomyelitis	63 (0.15)	3 (0.03)	60 (0.18)
Nervous system congenital anomalies	61 (0.14)	2 (0.02)	59 (0.17)
Menstrual disorders	42 (0.10)	1 (0.01)	41 (0.12)
Inflammatory conditions of male genital organs	40 (0.09)	4 (0.05)	36 (0.11)
Lung disease due to external agents	38 (0.09)	3 (0.03)	35 (0.10)
Phlebitis; thrombophlebitis and thromboembolism	34 (0.08)	2 (0.02)	32 (0.09)
Viral infection	33 (0.08)	2 (0.02)	31 (0.09)
Tuberculosis	30 (0.07)	0 (0.00)	30 (0.09)
Digestive congenital anomalies	29 (0.07)	1 (0.01)	28 (0.08)
Other male genital disorders	27 (0.06)	2 (0.02)	25 (0.07)
Disorders of teeth and jaw	25 (0.06)	1 (0.01)	24 (0.07)
Prolapse of female genital organs	25 (0.06)	0 (0.00)	25 (0.07)
Joint disorders and dislocations; trauma-related	24 (0.06)	1 (0.01)	23 (0.07)
Attention-deficit, conduct, and disruptive behaviour disorders	23 (0.05)	2 (0.02)	21 (0.06)
Urinary tract infections	22 (0.05)	1 (0.01)	21 (0.06)
Other female genital disorders	21 (0.05)	0 (0.00)	21 (0.06)
Acquired foot deformities	21 (0.05)	1 (0.01)	20 (0.06)
Other infections; including parasitic	20 (0.05)	3 (0.03)	17 (0.05)
Disorders usually diagnosed in infancy, childhood, or adolescence	17 (0.04)	2 (0.02)	15 (0.04)
Other disorders of stomach and duodenum	16 (0.04)	0 (0.00)	16 (0.05)
Menopausal disorders	16 (0.04)	0 (0.00)	16 (0.05)
Conditions associated with dizziness or vertigo	16 (0.04)	4 (0.05)	12 (0.04)
Noninfectious gastroenteritis	15 (0.04)	1 (0.01)	14 (0.04)
Otitis media and related conditions	13 (0.03)	1 (0.01)	12 (0.04)
Acute and chronic tonsillitis	12 (0.03)	1 (0.01)	11 (0.03)
Other skin disorders	12 (0.03)	1 (0.01)	11 (0.03)
Sexually transmitted infections (not HIV or hepatitis)	12 (0.03)	2 (0.02)	10 (0.03)
Impulse control disorders, NEC	6 (0.01)	0 (0.00)	6 (0.02)

Encephalitis (except that caused by tuberculosis or sexually transmitted disease)	5 (0.01)	0 (0.00)	5 (0.01)
Spinal cord injury	4 (0.01)	0 (0.00)	4 (0.01)
Endometriosis	2 (0.00)	1 (0.01)	1 (0.00)
Lymphadenitis	2 (0.00)	0 (0.00)	2 (0.01)
Nonmalignant breast conditions	1 (0.00)	0 (0.00)	1 (0.00)
Inflammatory diseases of female pelvic organs	1 (0.00)	0 (0.00)	1 (0.00)
Open wounds of head; neck; and trunk	1 (0.00)	0 (0.00)	1 (0.00)
Poisoning by nonmedicinal substances	1 (0.00)	0 (0.00)	1 (0.00)
CNS = central nervous system; COPD = chronic obstructive pulmonary disease; HIV = human immunodeficiency virus; NEC = not elsewhere classified			

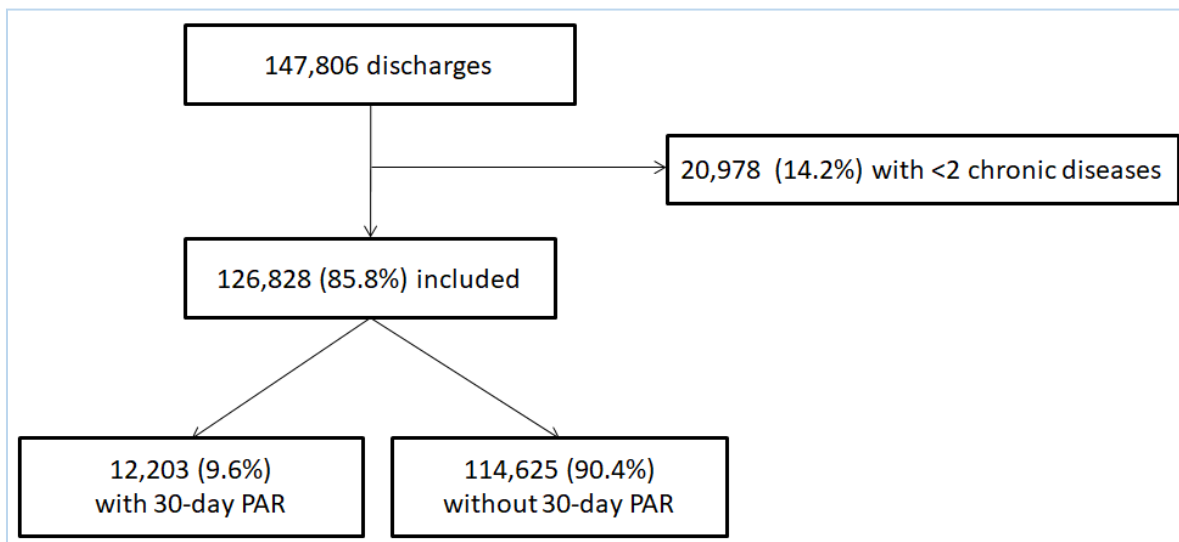
<b>Table S2: Prevalence of the different body systems in patients with multimorbidity (n = 33,871).</b>	
<b>Body system</b>	<b>n (%)</b>
Diseases of the circulatory system	20,816 (61.46)
Symptoms, signs, and ill-defined conditions	10,538 (31.11)
Diseases of the genitourinary system	10,436 (30.81)
Diseases of the nervous system and sense organs	8.806 (26.00)
Mental disorders	8.602 (25.40)
Diseases of the respiratory system	7.830 (23.12)
Neoplasms	7.744 (22.86)
Infectious and parasitic disease	6.828 (20.16)
Diseases of the musculoskeletal system	6.544 (19.32)
Diseases of the digestive system	6.531 (19.28)
Diseases of the skin and subcutaneous tissue	2712 (8.01)
Diseases of blood and blood-forming organs	2212 (6.53)
Injury and poisoning	2044 (6.03)

<b>Table S3: Combinations of comorbidities and their frequency in patients with multimorbidity (n = 33,871).</b>		
<b>Combinations of comorbidities</b>		<b>n (%)</b>
Chronic kidney disease	Chronic heart disease	3,217 (9.50)
COPD and bronchiectasis	Chronic heart disease	1,546 (4.56)
Chronic heart disease	Substance-related disorders	1,515 (4.47)
Pulmonary heart disease	Chronic heart disease	1,410 (4.16)
Peripheral and visceral atherosclerosis	Chronic heart disease	1,231 (3.63)
Paralysis	Cerebrovascular disease	1,157 (3.42)
Chronic heart disease	Arthropathy and arthritis	1,046 (3.09)
Chronic heart disease	Cerebrovascular disease	1,025 (3.03)
Acute and unspecified renal failure	Chronic heart disease	1,009 (2.98)
Chronic heart disease	Solid malignancy	977 (2.88)
Other nervous system disorders	Chronic heart disease	959 (2.83)
Other and ill-defined heart disease	Chronic heart disease	926 (2.73)
Thyroid disorders	Chronic heart disease	910 (2.69)
COPD and bronchiectasis	Substance-related disorders	868 (2.56)
Chronic heart disease	Dementia	817 (2.41)
Nephritis, nephrosis and renal sclerosis	Chronic kidney disease	789 (2.33)
Mood disorders	Chronic heart disease	769 (2.27)
Nephritis, nephrosis and renal sclerosis	Chronic heart disease	763 (2.25)
Diseases of white blood cells	Haematological malignancy	675 (1.99)
Paralysis	Chronic heart disease	611 (1.80)
Peripheral and visceral atherosclerosis	Chronic kidney disease	582 (1.72)
Liver disease	Substance-related disorders	565 (1.67)
COPD and bronchiectasis	Chronic kidney disease	557 (1.64)
Mood disorders	Substance-related disorders	531 (1.57)
Pulmonary heart disease	Chronic kidney disease	529 (1.56)
Other nervous system disorders	Chronic kidney disease	515 (1.52)
Chronic kidney disease	Arthropathy and arthritis	502 (1.48)
Solid malignancy	Substance-related disorders	485 (1.43)
Oesophageal disorders	Chronic heart disease	464 (1.37)
Anxiety disorders	Chronic heart disease	442 (1.30)
Chronic kidney disease	Dementia	435 (1.28)
Chronic heart disease	Liver disease	429 (1.27)
Chronic kidney disease	Solid malignancy	427 (1.26)
Pulmonary heart disease	COPD and bronchiectasis	425 (1.25)
Osteoporosis	Chronic heart disease	423 (1.25)
Thyroid disorders	Chronic kidney disease	409 (1.21)
COPD and bronchiectasis	Solid malignancy	407 (1.20)
Chronic heart disease	Haematological malignancy	397 (1.17)
Other nervous system disorders	Substance-related disorders	376 (1.11)
Chronic kidney disease	Substance-related disorders	355 (1.05)
Aortic; peripheral; and visceral artery aneurysms	Chronic heart disease	354 (1.05)
Other nervous system disorders	Arthropathy and arthritis	351 (1.04)
Hyperplasia of prostate	Chronic heart disease	340 (1.00)

Cardiac and circulatory congenital anomalies	Chronic heart disease	327 (0.97)
Diseases of white blood cells	Solid malignancy	326 (0.96)
Epilepsy; convulsions	Chronic heart disease	324 (0.96)
Other hereditary and degenerative nervous system conditions	Chronic heart disease	322 (0.95)
Chronic kidney disease	Mood disorders	322 (0.95)
Other nervous system disorders	Nephritis, nephrosis and renal sclerosis	321 (0.95)
Mood disorders	Miscellaneous mental health disorders	318 (0.94)
Paralysis	Other nervous system disorders	314 (0.93)
Acute and unspecified renal failure	Chronic kidney disease	307 (0.91)
Chronic ulcer of skin	Chronic heart disease	302 (0.89)
Other nervous system disorders	Mood disorders	290 (0.86)
Other nervous system disorders	Cerebrovascular disease	290 (0.86)
Occlusion or stenosis of precerebral arteries	Chronic heart disease	287 (0.85)
Chronic heart disease	Other nutritional/endocrine/metabolic disorders	282 (0.83)
Mood disorders	Solid malignancy	282 (0.83)
Anxiety disorders	Substance-related disorders	276 (0.81)
Mood disorders	Arthropathy and arthritis	271 (0.80)
Other nervous system disorders	Solid malignancy	271 (0.80)
COPD and bronchiectasis	Mood disorders	270 (0.80)
Cardiac and circulatory congenital anomalies	Cerebrovascular disease	263 (0.78)
Other and ill-defined heart disease	Chronic kidney disease	262 (0.77)
Peripheral and visceral atherosclerosis	COPD and bronchiectasis	261 (0.77)
Other circulatory disease	Chronic heart disease	257 (0.76)
Paralysis	Epilepsy; convulsions	257 (0.76)
Arthropathy and arthritis	Substance-related disorders	252 (0.74)
Peripheral and visceral atherosclerosis	Substance-related disorders	249 (0.74)
Osteoporosis	Arthropathy and arthritis	245 (0.72)
Mood disorders	Dementia	245 (0.72)
Pulmonary heart disease	Solid malignancy	245 (0.72)
Diseases of white blood cells	Chronic heart disease	243 (0.72)
Oesophageal disorders	Substance-related disorders	243 (0.72)
Cerebrovascular disease	Substance-related disorders	243 (0.72)
Other nervous system disorders	Dementia	241 (0.71)
Occlusion or stenosis of precerebral arteries	Cerebrovascular disease	234 (0.69)
Chronic kidney disease	Osteoporosis	233 (0.69)
Solid malignancy	Liver disease	233 (0.69)
Asthma	Chronic heart disease	232 (0.68)
Solid malignancy	Haematological malignancy	231 (0.68)
Acute and unspecified renal failure	Solid malignancy	231 (0.68)
Chronic kidney disease	Cerebrovascular disease	231 (0.68)
Chronic kidney disease	Other diseases of kidney and ureters	230 (0.68)
COPD and bronchiectasis	Arthropathy and arthritis	229 (0.68)
Miscellaneous mental health disorders	Chronic heart disease	227 (0.67)

Pulmonary heart disease	Substance-related disorders	227 (0.67)
Chronic kidney disease	Hematological malignancy	225 (0.66)
Acute and unspecified renal failure	Substance-related disorders	224 (0.66)
Epilepsy; convulsions	Substance-related disorders	223 (0.66)
Other hereditary and degenerative nervous system conditions	Other nervous system disorders	219 (0.65)
Epilepsy; convulsions	Solid malignancy	217 (0.64)
Other nervous system disorders	COPD and bronchiectasis	216 (0.64)
COPD and bronchiectasis	Acute and unspecified renal failure	212 (0.63)
Chronic kidney disease	Liver disease	211 (0.62)
Other nervous system disorders	Peripheral and visceral atherosclerosis	210 (0.62)
Dementia	Substance-related disorders	205 (0.61)
Paralysis	Solid malignancy	202 (0.60)
Thyroid disorders	Solid malignancy	199 (0.59)
Pulmonary heart disease	Other and ill-defined heart disease	197 (0.58)
Oesophageal disorders	Solid malignancy	197 (0.58)
Anxiety disorders	Mood disorders	195 (0.58)
Retinal detachments; defects; vascular occlusion; and retinopathy	Chronic heart disease	193 (0.57)
Chronic kidney disease	Chronic ulcer of skin	192 (0.57)
Diverticulosis and diverticulitis	Chronic heart disease	191 (0.56)
Thyroid disorders	COPD and bronchiectasis	190 (0.56)
Epilepsy; convulsions	Cerebrovascular disease	189 (0.56)
Oesophageal disorders	Chronic kidney disease	189 (0.56)
Thyroid disorders	Mood disorders	187 (0.55)
Peripheral and visceral atherosclerosis	Arthropathy and arthritis	187 (0.55)
COPD and bronchiectasis	Osteoporosis	186 (0.55)
Systemic lupus erythematosus and connective tissue disorders	Chronic heart disease	183 (0.54)
Solid malignancy	Arthropathy and arthritis	180 (0.53)
Retinal detachments; defects; vascular occlusion; and retinopathy	Other nervous system disorders	179 (0.53)
Thyroid disorders	Pulmonary heart disease	178 (0.53)
Retinal detachments; defects; vascular occlusion; and retinopathy	Nephritis, nephrosis and renal sclerosis	176 (0.52)
Thyroid disorders	Other nervous system disorders	173 (0.51)
Chronic kidney disease	Other nutritional/endocrine/metabolic disorders	171 (0.50)
Epilepsy; convulsions	Other nervous system disorders	171 (0.50)
Pulmonary heart disease	Acute and unspecified renal failure	171 (0.50)
Other lower respiratory disease	Chronic heart disease	170 (0.50)
Parkinson`s disease	Chronic heart disease	170 (0.50)
Thyroid disorders	Arthropathy and arthritis	170 (0.50)
COPD = chronic obstructive pulmonary disease		





**Figure S1:** Study inclusion and follow-up. PAR: potentially avoidable readmission.