Appendix 1

Table 1: Articles included for full-text reading (248 articles) and further included in the systematic review (150 articles), for additional references from checking reference lists please see Table 2 (page 96).

For both table 1 and 2 the following is applicable: articles marked yellow (112) are included as having individually developed definitions of multimorbidity. Articles marked purple (27) are included as having an index of multimorbidity and articles marked turquoise (21) are only partly included because of lack of information. NB. 3 articles are included both as having an index and a unique definition (marked both yellow and purple). Author names written in **bold** with a following **E** are those excluded after full-text reading.

Table 1.

Author	Year	Title	Population, art, age and number	Definition of MM	Number of disorders included and sources of data	Type of disorders if special disorders	Complications and risk factors included, if so what kind	Duration	Clusters and connections between disorders	Severity mentioned, if so how	Symptoms	Comments
Aarts	2011	Multimorbidity and its relation to subjective memory complaints in a large general population of older adults	N=15188, community-dwelling, >55 years, The Netherlands, cross-sectional, 2008.	2 or more and 3 or more	22 Self-reported medical conditions diagnosed by a medical doctor	Diabetes, Stroke/TIA, myocardial infarction, other heart problems (incl. heart failure and angina pectoris), malignancies, migraine, high blood pressure, narrowing of the veins in the abdomen or legs (no varicose veins), asthma/bronchitis/COPD, serious bowel problems (>3 months), psoriasis, chronic eczema, incontinence, serious back problems (incl. hernia), arthrosis, rheumatoid arthritis, other serious neck and shoulder problems,	Hypertension and osteoporosis.	Not mentioned.	Not mentioned.	Not mentioned.	Dizziness and falling, prostate complaints, serious bowel problems, incontinence, serious back problems, other serious neck and shoulder problems and other serious problems of the elbow, wrist or hand.	R

						other serious problems of the elbow, wrist or hand, osteoporosis, diseases of the nervous system (Parkinson's disease, multiple sclerosis, epilepsy), dizziness and falling and prostate complaints.						
Aarts	2011	Influence of MM on cognition in a normal aging population: a 12-year follow-up in the Maastricht Aging study.	N=1736, patients from the MAAS study (the Maastricht aging study) collected from the Registration Network Family Practices, The Netherlands, aged 24-81 years, recruited in 1992, prospective cohort study.	2 or more chronic	23 groups, 96 (ICPC-codes) conditions (some conditions were not grouped because of high prevalence or their effect on cognition) Medical records.	All malignancies, peptic ulcers, other chronic gastro-intestinal diseases, diseases of the eye, diseases of the ear, ischemic diseases, pulmonary embolism and phlebitis, cerebrovascular diseases, arrhythmias and heart failure, other cardiovascular diseases, movement disorders, Parkinsonism, migraine and headache, other diseases of the nervous system, mood disorders, Alzheimer, other mental disorders, asthma/COPD/bronchitis, other chronic respiratory diseases, eczema, psoriasis and chronic skin ulcer, endocrine diseases, diabetes (1 and 2) and diseases of the urinary tract.	No risk factors included. (Only complicated hypertension)	Only diagnoses that the GP considered as chronic (> 6 months), recurrent or with long-lasting consequences for functional status and prognosis. For incident diseases this was not the case. Time in years since diagnosis was incorporated to include the duration.	Diagnoses were grouped in 23 clusters.	They state that severity is important, but that they cannot measure it in this study.	Headache.	
Aarts	2012	The effect of multimorbidity on health related functioning: Temporary or persistent? Results from a	N=1184, patients from the MAAS study (the Mastricht aging study) collected from the Registration	2 or more chronic.	23 groups, 96 conditions Medical records. Also 12 conditions used to monitor incident cases: History of coma,	All malignancies, peptic ulcers, other chronic gastro-intestinal diseases, diseases of the eye, diseases of the ear, ischemic diseases,	No risk factors included.	Only diagnoses that by the GP was considered as chronic (> 6 months), recurrent or with long-lasting consequences for	Not mentioned.	Not mentioned.	Headache.	

		longitudinal cohort study.	Network Family Practices, The Netherlands, aged 24-81 years, recruited in 1992, longitudinal cohort study.		cerebrovascular disorder, tumor of the nervous system, multiple sclerosis, Parkinsonism, epilepsy, dementia, organic psychosis, schizophrenia, affective psychosis, mental retardation, or congenital malformation of the nervous system.	pulmonary embolism and phlebitis, cerebrovascular diseases, arrhythmias and heart failure, other cardiovascular diseases, movement disorders, Parkinsonism, migraine and headache, other diseases of the nervous system, mood disorders, Alzheimer, other mental disorders, asthma/COPD/bronchitis, other chronic respiratory diseases, eczema, psoriasis and chronic skin ulcer, endocrine diseases, diabetes (1 and 2) and diseases of the urinary tract.		functional status and prognosis. For incident diseases this was not the case				
Adams E	2012	Universal health outcome measures for older persons with multiple chronic conditions.	**Excluded: No definition of MM.** Not collected results.									D?
Agborsangaya	2012	Multimorbidity prevalence and patterns across socioeconomic determinants: a cross-sectional survey	N=4980, adults >18 years, general population, Alberta, Canada, cross-sectional, 2010.	2 or more chronic.	16 conditions. Self-reports	Diabetes, COPD, asthma, hypertension, high cholesterol, sleep apnea, congestive heart failure, obesity, depression or anxiety, chronic pain, arthritis, heart disease, stroke, cancer, GI-diseases and kidney diseases.	Hypertension, high cholesterol and obesity.	Not mentioned.	Found clusters; pairs; chronic pain- arthritis, triads; depression/anxiety-chronic pain-arthritis; quartets; hypertension-depression/anxiety-chronic pain-arthritis, quintets; diabetes-hypertension-high cholesterol-chronic pain-arthritis.	State that severity is important and that a further step could be to incorporate severity in the analyze. Also says that severity is included in Charlson, CIRS, the Index of Coexisting Diseases and the Kaplan Index.	Chronic pain.	D R
Akner	2009	Analysis of	N=70, residents	19 items in	41 diagnoses.	Neuropsychiatric	Osteoporosis.	Not mentioned.	Divided in groups	The patients	Itching over large	R

		multimorbidity in individual elderly nursing home residents. Development of a multimorbidity matrix.	in a nursing home (Sundbyberg, Sweden), cross-sectional, 2001-2002, mean age 85 years.	an MM matrix. The author filled in the quantitative number of problems and the patients then had to fill in the severity. Could grade it no=0, mild=1, moderate=2 and severe=3 total of 19*3=57 points. The total quantitative and qualitative score represent the grade of MM.	Clinical examination (also medical records) BMI, MMSE, ADL, GFR.	system (total 41 disorders); cogn. Impairment, right arm paralysis, expressive aphasia, dizziness, sleeping problems, stroke, cardiovasc syst; congestive heart failure, atrial fibrillation, AP, Respiratory syst; COPD, GI; constipation, dysphagia, Renal-urinary system; urinary incontinence, Gynecological, Endocrine-metabolism; diabetes, Haematology-biochemistry; B12-deficiency, substituted, Skeleton; Osteoporosis, Joints; contracture left knee, muscles; muscle weakness, skin; itching over large body areas, pain; pain in neck, lower back and left knee, eyes-vision; st post op cataract left eye, ears-hearing; hearing impairment, tinnitus, Smell-taste, allergy-hypersensitivity, malignant tumor; st post op c. coli 1985, nutrition state problems; involuntary weight loss 7kg/1 year			according to textbook in internal medicine in 19 items. Found that 50% of the residents had health problems in 8 out of 19 items. 100% in neuropsychiatric syst. 78% in CVD. 86 % in GI and 86 % in urinary tract.	reported the severity themselves.	body areas, dizziness, dysphagia and incontinence and weight loss. Muscle weakness.	
Aliotta E	2008	Guided care A New Frontier for Adults With Chronic Conditions	**Excluded: Theoretical article.**										

Alonso	2004	Health-related quality of life associated with chronic conditions I eight countries: Results from the International Quality of Life Assessment (IQOLA) Project.	N=between 2031-4084, general population from eight countries (Denmark, France, Germany, Italy, Japan, the Netherlands, Norway and the United States, cross-sectional, over 18 years old, 1994 (Denmark).	1 or more conditions, doesn't mention MM directly.	7 conditions, self-reports.	Allergies, arthritis, chronic lung disease, hypertension, ischemic heart disease, congestive heart failure, diabetes	Hypertension.	Ischemic heart disease the last year.	Not mentioned.	Not mentioned.	No symptoms included.	R
Altiner	2012	Activating general practitioners dialogue with patients on their agenda (Multicare AGENDA) study protocol for a cluster randomized controlled trial.	N=135, primary care setting, aged 65-84 years old, Germany. **NB protocol.**	3 or more conditions.	42 diagnosis groups. Interviews of medications taken.	Severe vision reduction, joint arthrosis, diabetes, CVD, thyroid dysfunction, cardiac arrhytmias, obesity, purine/pyramidine metabolism disorders/gout, prostatic hyperplasia, lower limb varicosis, liver disease, depression, asthma/COPD, noninflammatory gynaecological problems, atherosclerosis/PAOD, osteoporosis, renal insufficiency, cerebral ischemia/chronic stroke, heart failure, severe hearing loss, chronic cholecystitis/gallstones, somatoform disorders, hemorrhoids, intestinal diverticulosis, RA, cardiac valve disorders, neuropathies, dizziness, incontinence,	Obesity and osteoporosis.	Not mentioned.	Not mentioned.	Include diseases with a certain burden for the patient and that require medication.	Dizziness, incontinence, chronic headache, sexual dysfunction, insomnia and tobacco abuse.	R

						urinary tract calculi, anemias, anxiety, psoriasis, migraine/chronic headache, Parkinson's disease, cancers, allergies, chronic gastritis/GERD, sexual dysfunction, Insomnia, tobacco abuse and hypotension.						
Andrade	2010	Clustering of psychiatric and somatic illnesses in the general population: multimorbidity and socioeconomic correlates	N=1464, population-based sample, >18 years, Brazil, cross-sectional, 1994-1995.	2 or more conditions.	8 somatic disorders and 15 psychiatric, self-reported.	Somatic: High blood pressure, asthma, heart disease, diabetes, stroke, cancer, headache and low back pain. Psychiatric: cognitive impairment, non-affective psychosis, panic attacks, GAD, any phobias, OCD, depression, dysthymia, bipolar disorder, bulimia, alcohol use disorder, substance use disorder, nicotine dependence, somatoform disorder, dissociative disorder.	High blood pressure.	Not mentioned for the somatic problems. For some of the psychiatric disorders there are some questions related to feelings and have "you felt for a period of longer than two weeks…" have you had feelings of anxiety and tension for more than one month..."	More physical symptoms if psychological distress. Asthma and anxiety, mood and substance abuse and dissociative and somatoform disorders.	Not mentioned.	Headache, low back pain alcohol use disorder, substance use disordeand nicotine dependence.	D X? R
Aspin E	2010	Health policy responses to rising rates of multi-morbid chronic illness in Australia and New Zealand	**Excluded: No definition of multimorbidity.**									
Ataguba	2013	Inequalities in multimorbidity in South Africa	N=28129 (2005), N=28002 (2006), N=29311 (2007) and N=24293 (2008), South Africa, general population, age	2 or more conditions.	9 illnesses (account for most premature death) and 6 disabilities, self-reported.	Illnesses; Diarrhea, trauma, TB, drugs, depression, diabetes, high BP, HIV and STD. Disabilities; sight, hearing, speech, physical, intellectual,	High blood pressure.	Recall for illnesses - 1 month, for disabilities – 6 months. Difficulties to distinguish between co-occurring at the same time or in a period of time.	Not mentioned.	Not mentioned.	Disabilities; sight, hearing, speech, physical, intellectual, emotional.	R D

			not stated (mean app 26 years). Cross-sectional?			emotional.						
Autenrieth	2013	Physical activity is inversely associated with MM in elderly men: Results from the KORA-Age Augsburg Study	N=1007 men and women, aged 65-94 years, between 2008/2009, population-based, Germany, cross-sectional.	2 or more conditions.	13 chronic diseases, self-reports – questionnaires and telephone.	Hypertension, eye disease, heart disease, diabetes, joint disease, lung disease, GI disease, mental disease, stroke, cancer, kidney disease, neurological disease, liver disease.	Hypertension.	Not mentioned.	CMD cluster identified – hypertension, heart disease, diabetes, and stroke and kidney disease.	Not mentioned.	No symptoms included.	R
Barnett	2012	Epidemiology of multimorbidity and implications for health care, research, and medical education: a cross-sectional study.	N=1751841, 1/3 of the general Scottish population, Scotland, no age limit, cross-sectional, 2007.	2 or more chronic conditions.	40 disorders, medical records.	Depression, hypertension, Painful condition, Asthma (currently treated), Coronary heart disease, Treated dyspepsia, Diabetes, Thyroid disorders, Rheumatoid arthritis, other inflammatory polyarthropathies & systematic connective tissue disorders, Chronic obstructive pulmonary disease, Anxiety & other neurotic, stress related & somatoform disorders, Irritable bowel syndrome, New diagnosis of cancer in last five years, Alcohol problems, Other psychoactive substance misuse, Treated constipation, Stroke & transient ischemic attack, Chronic kidney disease, Diverticular disease of intestine, Atrial fibrillation,	Hypertension.	For any diagnose based on prescription: > 12 months.	Not mentioned.	Not mentioned.	Painful condition, treated dyspepsia, and treated constipation.	X? D R

						Peripheral vascular disease, Heart failure, Prostate disorders, Glaucoma, Epilepsy (currently treated), Dementia, Schizophrenia (and related non-organic psychosis) or bipolar disorder, Psoriasis or eczema, Inflammatory bowel disease, Migraine, Blindness & low vision, Chronic sinusitis, Learning disability, Anorexia or bulimia, Bronchiectasis, Parkinson's disease, Multiple sclerosis, Viral Hepatitis and Chronic liver disease.						
Bayliss E	2007	Supporting self-management for patients with complex medical needs; recommendations of a working group.	**Excluded: Theoretical article.**									
Bernabeu-Wittel	2009	Peeking through the cracks: An assessment of the prevalence, clinical characteristics and health-related quality of life of people with polypathology in a hospital setting.	N=812, hospitalized patients, Seville, Spain, 2007, transversal study (including five prevalence studies). No age limit.	2 or more chronic diseases included in two or more clinical categories.	Diseases included in two or more of 8 clinical categories A-H. Personal interview and assessment. Excluded if cognitive impairment or delirium. BMI, Hb and albumin, Mini nutritional Assessment questionnaire and SF-12 were measured.	Cat A: heart failure and ischemic heart disease, Cat B: autoimmune diseases or chronic renal disease, Cat C: COLD, Cat D: Chronic infl bowel disease or chronic liver disease, Cat E: stroke or neurol disease leading to motor deficit or cognitive impairment, Cat F: peripheral artery disease or diabetes with compl. Cat G: chronic anemia or cancer without	No risk factors included.	Chronic renal disease creatinemia or proteinuria for at least 3 months.	Divided into groups. But not mentioning clustering.	Only included diseases with a certain level of severity; for HF at least NYHA II, COPD stage 2 dyspnea, liver disease with portal hypertension, neurological disease with reduction in BI or cognitive impairment Pfeiffer's test > 5 errors, symptomatic artery disease, diabetes with	No symptoms included.	

						curative possibilities, Cat H: chronic osteoarticular disease.				retinopathy and symptomatic neuropathy, anemia for more than 3 months, cancer and osteoarthritis affecting BI.		
Bernabeu-Wittel	2011	Development of a new predictive model for polypathological patients. The PROFUND index.	N=1632, patients treated in internal medicine and geriatric areas from 33 Spanish hospitals, Feb 2007 to June 2008, Spain. Aged 18 years and older. Observational prospective with follow-up 12 months.	2 or more chronic diseases included in two or more clinical categories.	Assessment with questionnaire, BI, ADL, Charlson, symptoms and signs, cognitive impairment, hospital admissions the last 12 months, drugs, socio-familial data and SF-12 were measured. BMI, Hb, HbA1c, CRP, albumin, creatinine, Mini nutritional.	Cat A: heart failure and ischemic heart disease, Cat B: autoimmune diseases or chronic renal disease, Cat C: COLD, Cat D: Chronic infl bowel disease or chronic liver disease, Cat E: stroke or neurol disease leading to motor deficit or cognitive impairment, Cat F: peripheral artery disease or diabetes with compl. Cat G: chronic anemia or cancer without curative possibilities, Cat H: chronic osteoarticular disease.	No risk factors included.	Chronic renal disease creatinemia or proteinuria for at least 3 months.	Divided into groups. But not mentioning clustering.	Only included diseases with a certain level of severity; for HF at least NYHA II, COPD stage 2 dyspnea, liver disease with portal hypertension, neurological disease with reduction in BI or cognitive impairment Pfeiffer's test > 5 errors, symptomatic artery disease, diabetes with retinopathy and symptomatic neuropathy, anemia for more than 3 months, cancer and osteoarthritis affecting BI.	Say that they collect information on signs and symptoms but not what it covers.	
Bernabeu-Wittel	2011	A multi-institutional, hospital-based assessment of clinical, functional, sociofamilial and health-care characteristics of polypathological patiens (PP)	N=1632, patients treated in internal medicine and geriatric areas from 36 Spanish hospitals, Feb 2007 to June 2008, aged 18 years and older. Cross-sectional.	2 or more chronic diseases included in two or more clinical categories.	Excluded if they died during their stay and if they did not agree to participate. Assessment with questionnaire, BI, ADL, Charlson, symptoms and signs, cognitive impairment, hospital admissions the last 12 months, drugs, socio-familial	Cat A: heart failure and ischemic heart disease, Cat B: autoimmune diseases or chronic renal disease, Cat C: COLD, Cat D: Chronic infl bowel disease or chronic liver disease, Cat E: stroke or neurol disease leading to motor deficit or cognitive impairment, Cat F:	No risk factors included.	Chronic renal disease creatinemia or proteinuria for at least 3 months.	Divided into groups. But not mentioning clustering.	Only included diseases with a certain level of severity; for HF at least NYHA II, COPD stage 2 dyspnea, liver disease with portal hypertension, neurological disease with reduction in BI or cognitive impairment	Say that they collect information on signs and symptoms but not what it covers.	

					data and SF-12 were measured. BMI, Hb, HbA1c, CRP, albumin, Mini nutritional.	peripheral artery disease or diabetes with compl. Cat G: chronic anemia or cancer without curative possibilities, Cat H: chronic osteoarticular disease.				Pfeiffer's test > 5 errors, symptomatic artery disease, diabetes with retinopathy and symptomatic neuropathy, anemia for more than 3 months, cancer and osteoarthritis affecting BI.		
Blaum	2002	Low cognitive performance, comorbid disease and task-specific disability: findings form a nationally representative survey	N=7442, 70 years or older, US, 1993, cohort study, nationally representative.	No spec cut-off.	Interviews, self-reported. Functional limitation, IADL, ADL, low cognitive performance.	Cardiovascular: Heart and lung diseases; musculoskeletal: back problems, arthritis and hip fracture, diabetes; stroke; group of diseases not ass with task difficulty i.e. hypertension, cancer. Self-reported problems with vision and hearing; depressive symptoms – depression scale.	Hypertension.	Not mentioned.	Divided into related groups. But not mentioning clustering.	Vision and hearing divided into fair poor and for vision also blind.	Back problems, problems with vision and hearing.	R
Boult E	2008	Early effects of "guided care" on the quality of health care for multimorbid older persons: a cluster-randomized controlled trial	**Excluded: no definition of MM.** Only describes the risk of using health service the following year. Describes less than the 1-year pilot study, therefore this study is excluded and the other included.									D
Boult E	2011	The effect of Guided Care Teams on the use of health services	**Excluded: no definition of MM.** Only describes the risk of using health service									D

			the following year. Just mention that they use the claims based hierarchical condition category (HCC) predictive model, but do not explain more.									
Boyd E	2007	Guided care for multimorbid older adults	**Excluded: no definition of MM**.									
Boyd E	2007	Framework for evaluating disease severity measures in older adults with comorbidity.	**Excluded: narrative synthesis**. They choose a number of specific conditions but they are not making an actual MM def.									D!
Boyd	2008	A pilot test of the effect of guided care on the quality of primary care experiences for MM older adults.	N=150, community dwelling, Oct 2003 to Sept 2004. 65 and older. Baltimore, US, nonrandomized prospective clinical trial.	**John Hopkins Adjusted Clinical groups predictive model (acg PM (predictive model)) –** Includes: total disease burden, age, gender, medications, resource use, population markers, medical conditions and calculated a risk score (just text marked with bold is	9 diseases. Claims data; based on John Hopkins Adjusted Clinical groups predictive model (acg PM) with the 18 % with the highest risk of health care use the following year was selected. 98 went through the test divided in a control-group and a guided care group.	Ischemic heart disease, heart failure, hypertension, diabetes, osteoarthritis, COLD, depression, dementia and Parkinson's disease.	Hypertension.	Not mentioned.	Not mentioned.	Not mentioned.	No symptoms included.	R

				stated in the article).								
Boyd E	2008	From Bedside to Bench: summary from the American Geriatrics Society/National Institute on Aging Research Conference on Comorbidity and Multiple Morbidity in Older Adults.	**Excluded: Theoretical article.**									D?
Boyd E	2010	The effects of guided care on the perceived quality of health care for multi-morbid older persons: 18-month outcomes from a cluster-randomized controlled trial.	**Excluded: No definition of MM.** The health insurance was searched with hierarchical condition category (HCC) predictive model, estimating the risk of using health care the following year.									
Boyd E	2011	Future of MM Research: How should Understanding of multimorbidity Inform health system design?	**Excluded: Theoretical article.**									D!
Brettschnieder	2013	Relative impact of multimorbid chronic conditions on health related quality of life – results from the multicare cohort study.	N=3189, primary care patients, July 2008-Oct 2009, 65-85 years old, cohort-study, Germany.	3 or more chronic conditions.	To be included conditions from a list of 29 conditions and at least one visit to the GP the last 3 months. MM was then assessed by a GP questionnaire with 46 groups based on prevalence. The codes are used together if diseases have the same pathophysiology or if the ICD 10 codes are used unclear in	Hypertension, lipid metabolism disorders, chronic low back pain, joint arthrosis, diabetes, thyroid dysfunction, chronic ischemic heart disease, cardiac arrhythmias, asthma/COLD, varicosis, osteoporosis, vision reduction, cancer, depression, purine/pyrimidine metabolism disorders and gout,	Hypertension, lipid metabolism disorders, obesity and osteoporosis.	Not mentioned.	The ICD codes are classified together if they share pathophysiology, but not mentioning clustering.	Have a severity rating in the questionnaire based on prognosis and burden of disease: 0=no problem, 4= severe problems. They calculated a weighted count score based on this.	Chronic low back pain, dizziness, urinary incontinence, sexual dysfunction, and tobacco abuse.	R

					pracGP questionnaires. The list consisted of 45 diseases in the end including 7 extra after open questions and excluding dementia. Interview.	atherosclerosis/peripheral arterial occlusive disease, diverticulosis, neuropathies, cardiac insufficiency, cerebral ischemia/chronic stroke, prostatic hyperplasia, renal insufficiency, cardiac valve disorders, chronic cholecystitis/gallstones, dizziness, liver disease, haemorrhoids, urinary incontinence, somatoform disorders, hearing loss, anemias, rheumatoid arthritis/chronic polyarthritis, anxiety disorders, psoriasis, migraine/chronic headache, non-inflammatory gynecological problems, Parkinson's disease, urinary tract calculi, finally; chronic gastritis/gastroesophageal reflux, insomnia, allergies, obesity, hypotension, sexual dysfunction and tobacco abuse.						
Brillemaan	2012	Comparing measures of MM to predict outcomes in primary care: a cross sectional study	N=95372, a random sample from the General Practice Research Database (representative for the general population), aged 18 years	MM defined in six ways: 1. Simple count of 17 diseases included in the Quality and Outcomes Framework (QOF).	General Practice Research Database (representative for the general population). **QoF:** 17 conditions. **Charlson:** 17 conditions. **EDC**: 264 EDC's where 114 are classified as chronic	**QoF:** Asthma, atrial fibrillation, cancer, coronary heart disease, chronic kidney disease, COPD, dementia, depression, diabetes, epilepsy, heart failure, hypertension, learning disability,	**QoF:** Hypertension and obesity. **Charlson:** No risk factors included. **EDC:** Hypertension, disorders of lipid metabolism,	Not stated specifically.	Not stated specifically.	Charlson and ADG include severity.	**QoF:** Smoking. **Charlson:** No symptoms. **EDC:** Low back pain, quadriplegia and paraplegia, and substance use. **ADG:** Backache, cannabis abuse,	D RI

			and older, 1 April 2005-31 March 2008, UK, cross-sectional.	2. Charlson Index score. 3. John Hopkins University ACG Case-Mix System with Expanded Diagnosis Clusters (EDC). 4. Aggregated Diagnosis Groups (ADGs). 5. Resource Utilization Bands (RUB) based on expected resource demands. 6. Number of drugs prescribed 1 April 2004-31 March 2005.	(Salisbury et al.). Organized in 27 groups. **ADG:** Includes approx. 25 000 ICD 10 codes and 32 clinical groups. **RUBs:** Aggregation of ACG into 6 ordinal categories based on expected health care resource demands. **BNF:** Number of codes appearing in individual's prescription drug data.	mental health problem (psychosis, schizophrenia, bipolar affective disorder), obesity, stroke, thyroid disease. **Charlson Index score (adapted for Read coded data):** Cerebrovascular disease, chronic pulmonary disease, congestive heart disease, dementia, diabetes, diabetes with complications, hemiplegia and paraplegia, mild liver disease, moderate or severe liver disease, myocardial infarction, peptic ulcer disease, peripheral vascular disease, renal disease, rheumatological disease, cancer and metastatic tumour. **EDC:** 114 diagnoses all will not be listed here. Also include surgical procedures. **ADG:** almost all diagnoses. **RUBs:** Same as ACG. **BNF:** No conditions.	obesity and osteoporosis. **ADG:** Hypertension, etc. **RUBs:** Same as ACG. **BNF:** Drug data.				etc. **RUBs:** Same as ACG. **BNF:** No drug data.	
Britt	2008	Prevalence and patterns of MM in Australia	N=9156, prospective cohort study, July-Nov 2005, not stated age limit but report a category < 25 years, general practice and the population, Australia.	Illnesses in 2 or more morbidity domains in CIRS.	GPs asked which morbidities from a list is currently managed, with use of their knowledge to the patient, patient's self-reports and medical records. The disorders were allocated to the 14 domains of CIRS	Cardiac: ischemic heart disease, heart failure, vascular: hypertension, peripheral vascular disease, hyperlipidemia, other cardiovascular disease, neurological: cerebrovascular disease,	Hypertension and hyperlipidemia.	Not mentioned.	Not more than the domains in CIRS.	CIRS contains a measure of severity for each domain.	Back pain, insomnia and other psychological problem.	RI

					and it resulted in 8 out of 14 domains (based on Hudon et al.) and one extra for malignant neoplasms. In total 9 domains.	psychological: depression, anxiety, insomnia, other psychological problem, respiratory: asthma, COLD, musculoskeletal: arthritis, chronic back pain, endocrine: diabetes, upper GI: gastro-oesophageal reflux disease, not applicable: malignant neoplasm.						
Buchner E	2012	The new risk adjustment formula in Germany: Implementation and first experiences	**Excluded: Theoretical article.** Discussing how to decide on and implement a new risk adjustment scheme for health insurance.									D!
Burgers	2010	Quality and coordination of care for patients with multiple conditions: results from an international survey of patient experience.	N=8973, 8 countries; Australia, Canada, France, Germany, the Netherlands, New Zealand, UK, and US. Aged 18 years and older, nationally representative, telephone-survey, cross-sectional.	2 or more chronic conditions.	Commonwealth Fund International Health Policy Survey 2008 – a telephone based survey. 7 conditions included, later reduced to 5-but not stating what 5. Classified patients in three ways: 1. Burden of morbidity – number of chronic condition and self-reported health status with a maximum of 10 points – N + (2*HS)-1 (N=number of conditions, HS=health status 1=good, 2=fair 3=poor). 2. Type of chronic condition.	Hypertension, heart disease, diabetes, arthritis, chronic lung problems, mental health problems and cancer.	Hypertension.	Not mentioned.	Every condition was counted as one except when hypertension occurred together with heart disease or diabetes, because having these latter diseases will automatically lead to antihypertensive treatment and will not increase the burden. Concordant disorders = hypertension, heart disease and diabetes.	Burden of morbidity – number of chronic condition and self-reported health status with a maximum of 10 points – N + (2*HS)-1 (N=number of conditions, HS=health status 1=good, 2=fair 3=poor).	Chronic lung problems and mental health problems.	D R

					3. Whether the conditions are concordant or discordant.							
Busato	2012	Improving the quality of morbidity indicators in electronic health records in Swiss primary care.	N=509,594, consultations from 98. 152 primary care patients, Switzerland. Oct 2008-June 2011, not stated age, cross-sectional study.	1 chronic condition or more= chronic patient.	Electronic medical records (EMR) with ICPC-codes and PCG Pharmaceutical cost groups. In EMR there is no predefined list of included conditions (Chmiel et al. 2011). Only ICPC-2 or prescribed medication.	ICPC: Coronary and peripheral vascular disease, epilepsy, hypertension, HIV/AIDS, tuberculosis, rheumatologic conditions, hyperlipidemia, malignancies, Parkinson's disease, renal disease (including ESRD), cardiac disease/ASCVD/CHF, diabetes, glaucoma, peptic acid disease, cystic fibrosis, transplantations, respiratory illness, asthma, thyroid disorders, Crohn's and ulcerative colitis, pain and inflammation, pain, depression, psychotic illness, anxiety and tension. Also corresponding pharmaceutical information.	Hypertension and hyperlipidemia.	They checked the completeness by controlling for a corresponding diagnosis documented during the same or an earlier consultation. No spec time mentioned.	Not mentioned.	Not mentioned.	Pain.	R
Byles	2005	Single index of multimorbidity did not predict multiple outcomes.	N=1303, Australia, patients from the Department of Veteran's Affairs (DVA) Preventive Care Trial (PCT) randomly selected from Commonwealth DVA database, aged 70 years or more, prospective cohort study.	No spec cut-off.	List of 25 conditions. Telephone interviews and self-administered MM-questionnaire. With annual telephone interviews for 3 years follow up.	Arthritis, vision problems, hypertension, sciatica, back or spinal problems, hearing problems, forgetfulness, digestion problems, urinary tract problems, chronic allergic or sinus problems, dermatitis or other chronic skin problems, chronic pain, angina or chest pain,	Hypertension.	Not mentioned.	Not mentioned.	Had to report in the questionnaire the severity of each condition 1=good, 7=bad.	Vision problems, back or spinal problems, hearing problems, forgetfulness, digestion problems, urinary tract problems, chronic pain, chest pain, muscle weakness or spasm, fits, faints and funny turns.	R

						depression, cancer, chronic lung disease, muscle weakness or spasm, heart attack, gall bladder trouble, fits, faints, funny turns, heart bypass, kidney problems, diabetes, stroke, heart failure, liver problems.						
Calderon Larranaga	2012	Multimorbidity, polypharmacy, referrals, and adverse drug events: Are we doing things well?	N=79089, Zaragoza, Spain. Retrospective observational study. Patients over 14 years treated in general practice centers. 2008.	RUB 1 to RUB 5 (1= healthy and 5=very high morbidity). No cut-off.	Included if they had seen the GP once during 2008 and was assigned to the same doctor the 31 of December 2008. Electronic medical records and Aragón pharmacy database. Used the Adjusted Clinical Groups System (ACG) divided patients into 106 homogenous categories based on diagnostic, demographic and need-for-care variables. Patients were categorized into groups with same level of MM into resource utilization bands (RUB). Adverse Drug Events were found in the medical record as ICPC codes.	106 categories of ICPC all diagnoses not specifically mentioned (some mentioned in Starfield et al. 1990 and John Hopkins reference manual).	In ACG Hypertension is included.	Not mentioned.	Are categorized in levels of MM in RUB.	Severity included ACG includes frailty.	ACG includes headache, palpitation and chest pain.	RI
Capobianco E	2013	Comorbidity: a multidimensional approach	**Excluded: theoretical article.**									D
Caracciolo	2013	Relationship of Subjective Cognitive Impairment and cognitive impairment no dementia to chronic disease and	N=11379, Sweden, twin study, 1998-2001 all twins registered and alive over 65 years were included, cross-sectional.	2 or more chronic conditions.	List of diseases, do not mention in text how many. Sources of data: inpatient register in Sweden (from 1969) and self-and informant reports. Cognitive	Mental; psychosis and affective disorders, circulatory; ischemic heart disease, cardiac dysrhythmia, heart failure, hypertension,	Hypertension and osteoporosis.	Not mentioned.	Divided the diseases in groups and reported results according to each group, not the disease.	Not mentioned.	No symptoms included.	X R

		multimorbidity in a nation-wide twin study.			performance: interview, personal questions about living situation, dementia rating scale, persons under suspicion of dementia underwent an investigation. Divided in dementia (according to DSM-IV), SCI (subjective cognitive impairment), CIND (cognitive impairment no dementia) and NCI (no cognitive impairment). Also screened for depressive symptoms and anxiety.	stroke, musculoskeletal; articular diseases, osteoporosis, hip fracture, respiratory; COLD, emphysema, asthma, endocrine; diabetes, thyroid dysfunction, GI; intestinal diverticula, ulcerous colitis, Crohn's disease, liver cirrhosis, cholelithiasis, urological; renal failure, renal calculosis, prostate hypertrophy, recurrent cystitis, malignant tumors.						
Caughey E	2008	Prevalence of comorbidity of chronic diseases in Australia.	**Excluded: Co-morbidity (also systematic review)**.									D
Chan	2002	Survey of major chronic illnesses and hospital admissions via the emergency department in a randomized older population in Radwick, Australia.	N=526, Older dwelling in the community, 55 years and older, Randwick, Australia, randomly selected. March 1998-June 1999. Cross-sectional, survey.	No spec cut-off.	List of 10 disease groups. Questionnaire. Based on self-reports of doctor's diagnoses and medications taken, not cross-checked with GP. Also, hospital admission data to collect information of unplanned admissions.	Diabetes, hypertension, stroke, ischemic heart disease (angina or heart attack), musculoskeletal disorders (osteoarthritis, RA, osteoporosis, fracture), GI-disease (ulcer or reflux), neoplasm/cancer, chronic airways limitation (bronchitis, emphysema), dementia and others.	Hypertension and osteoporosis.	Not mentioned.	Not more than grouping the diseases in 10 groups.	Not mentioned.	No symptoms included.	R
Cheng Not states number	2003	Health related quality of life in pregeriatric patients with chronic diseases	N=316, 55-64 years old, June 2001-August 2001, Houston, Texas,	Not specified, just count chronic disorders.	Medical chart. Referred by their GP if at least one ICD-9 code for a chronic disease.	Not stated a number or what conditions.	Not mentioned.	Not mentioned.	Not mentioned.	Not mentioned.	Not mentioned.	

and type of conditions.		at urban, public supported clinics.	cross-sectional, consecutive patients in publicly supported county clinics.		The investigators then confirmed the age and presence of the chronic condition, by using the medical record. Then the patients underwent an interview and a SF-36.							
Cheung	2013	Association of handgrip strength with chronic diseases and MM.	N=1145, Hong Kong, recruited 1998-2009, handgrip strength data collected in the end of 2002, cross-sectional, aged 50 years and over, community dwelling.	No spec cut-off. Chronic conditions.	18 chronic diseases. Present in database and with prevalence over 1 % in the study population. Questionnaire administered by a nurse or investigator. The medical record was then confirmed.	1. Anemia, 2. Anxiety, 3. Cataract, 4. Cerebral vascular accident (stroke), 5. Chronic kidney disease (CKD) (eGFR under 60), 6. COPD, 7. Depression, 8. Diabetes, 9. History of fall in the past 12 months, 10. Hepatitis B, 11. Hyperlipidemia, 12. Hypertension, 13. Hyperthyroidism, 14. Ischemic heart disease, 15. Kyphosis, 16. Malignancy within 5 years, 17. Osteoarthritis knee and 18.Peptic ulcer.	Hyperlipidemia and hypertension.	Malignancy within 5 years.	Not mentioned.	CKD with eGFR below 60.	No symptoms included. Included history of falls the last 12 months.	X R
Chi	2011	Multiple morbidity combinations impact on medical expenditures among older adults	N=221,256 Taiwan, national population, aged 50 years old. 2001. Cross-sectional.	No spec cut-off.	Claims data. Collected information on 8 chronic conditions. First stage also ADL, IADL and cognitive function to investigate functional status. If they had problems they were considered disabled and included for further evaluation.	Hypertension, diabetes, heart disease, stroke, dementia, cancer, COPD and arthritis. After Fisher et al.	Hypertension.	To be considered to have the disease they should have been hospitalized more than once or treated at outpatient clinic more than three times for the same diagnosis.	Not mentioned.	Not mentioned.	No symptoms included.	X? R
Condelius do not specify more than	2008	Hospital admissions among people 65+ related to MM, municipal and outpatient care.	N=4907, 65 years and older, Sweden, from 4 municipalities, to be included 1 or more	No spec. cut-off. Both acute and chronic conditions.	Including 17 of the 21 chapters in ICD-10. Register (PASIS in Skane)	Not listing specific diseases. Includes everything except: (excluding chapter 20: external causes of morbidity and mortality, 21:	Not specified.	Not mentioned.	Divided in the chapters in ICD-10, but do not mention clustering.	Not mentioned.	Not specified.	D

stated here			admission the previous year (2001), cross-sectional.			factors influencing health status and contact with health services, 15: pregnancy, childbirth and puerperium and 16: certain conditions originating in the perinatal period).						
Condeliu s do not specify more than stated here	2010	Utilization of medical healthcare among people receiving long-term care at home or in special accommodation	N=694, (Patients having one or more hospital admission during 2001). 65 years or older, received help from municipality (either at home or in a nursing home). Skåne, Sweden. Cohort study.	Not a specific cut off.	Register data: PASIS. Counted ICD-10 codes from PASIS. Multimorbidity calculated by putting these diagnoses into chapters in the ICD-10 system, only 17 of 21 chapters were included. Also collected data on staircase ADL, the Berger scale, PADL and IADL. And the following health complaints: dizziness, urinary and feces incontinence, anxiety, depressed mood, pain and ulcers.	Not stated specifically what disorders.	Not mentioned.	Not mentioned.	Not mentioned more than chapters in ICD-10.	Not mentioned.	Dizziness, urinary and feces incontinence, anxiety, depressed mood, and pain.	D
Cox E	2011	Underrepresentation of individuals 80 years of age and older in chronic disease clinical practice guidelines	**Excluded: No definition of MM.**									
Cullen E	2009	Chronic illness and MM among problem drug users: a comparative cross sectional pilot study in primary care	**Excluded: No definition of MM.**									
Dattalo	2012	Who participates in chronic disease self-management (CDSM)	N=241, Maryland, US. 65 years and older (the	No spec cut-off. Chronic conditions.	Self-reports (telephone and person-to-person interviews) of 13	Diabetes, hypertension, heart attack, angina, congestive heart	Hypertension and osteoporosis.	Not mentioned.	Not mentioned.	Not mentioned.	No symptoms included.	D? R

		programs? Differences between participants and nonparticipants in a population of multimorbid older adults	highest 25% of Medicare service users, using HCC to predict admission the following year, which was one arm from (intervention) the Guided Care model RCT) were invited by mail and followed up by telephone and person-to-person interviews.		chronic conditions. Also functional health SF-36, self-rated health (poor-excellent), ADL, IADL, Patient activation (Patient Activation Measure), quality of chronic illness care.	failure, other heart condition, asthma/COPD/emphysema, arthritis, sciatica, cancer, osteoporosis, hip fracture and Alzheimer's disease.						
de Bruin E	2012	Comprehensive care programs for patients with multiple chronic conditions: a systematic literature review	**Excluded: Systematic review.**									
Deeg	2002	Health profiles and profile-specific health expectancies of older women and men: The Netherlands	N=1659, The Netherlands. Nationally representative cohort. 65-85 years old. 1992-1993 and 1995-1996, cohort study.	No spec. cut-off. Chronic conditions.	Baseline 1992-1993 (first round): interviews and tests. Second round 1995-1996: face-to-face interview. Self-reported 7 chronic diseases and medical treatment of them, self-reported functional limitations, test of physical performance, vision, hearing, depressive symptoms and cognitive impairment. Also asked about upper body performance, etc.	Respiratory diseases, heart diseases, atherosclerosis, diabetes, stroke, arthritis and cancer. Could also report any additional condition: hypertension, back problems, or GI-disorders.	Hypertension.	Not mentioned.	Not mentioned.	If the patient reported a disease they were asked about use of prescribed drugs and regular contacts with a physician to indicate medical severity.	Back problems.	R
De Groot E	2003	How to measure comorbidity: a critical review of available methods	**Excluded: review.**									

De Maeseneer E	2011	Care for noncommunicable diseases (NCDs): time for a paradigm-shift	**Excluded: Theoretical article**.									
Demirchyan E	2013	Short and long term determinants of incident multimorbidity in a cohort of 1988 earthquake survivors in Armenia.	**Excluded: No definition of MM.**									
Dennis E	2013	Do people with existing chronic conditions benefit from telephone coaching? A rapid review	**Excluded: Review.**									
de Vries E	2012	Effects of physical exercise therapy on mobility, physical functioning, physical activity and quality of life in community-dwelling older adults with impaired mobility, physical disability and/or multi-morbidity: a meta-analysis	**Excluded: meta-analysis.**									
Diedericks E	2011	The measurement of multiple chronic diseases-a systematic review on existing MM indices.	**Excluded: Systematic review.**									
Diedericks	2012	How to weight chronic diseases in multimorbidity indices? Development of a new method on the basis of individual data from five population-based studies	N=3916, from five different population-based studies in Germany, aged 65 years and older, from different time periods 1997-2009. Different designs, both cross-sectional,	No spec cut-off. Chronic conditions.	10 chronic conditions at least occurring in three of five studies. Self-reports with questionnaire.	Cancer, diabetes mellitus, hypertension, myocardial infarction, stroke, COPD, arthrosis, thyroid disease osteoporosis and asthma.	Hypertension and osteoporosis.	One study used occurrence the last five years instead of lifetime prevalence.	Not mentioned.	Not mentioned.	No symptoms included.	R

			prospective, etc.									
Dominick E	2012	Unpacking the burden: understanding the relationships between chronic pain and comorbidity in the general population	**Excluded: Co-morbidity.**									
Drewes	2011	The effect of cognitive impairment on the predictive value of multimorbidity for the increase in disability in the oldest old: the Leiden 85-plus Study	N=594, Prospective cohort study (5-years follow-up), The Netherlands, Sep 1997-Sep 1999, general population, aged 85 years old.	2 or more chronic diseases.	Medical records, 9 chronic diseases. Interviews and cognitive testing for ADL and MMSE.	Arthritis, COPD (also if taking lung medication at the age of 85), diabetes, heart failure, stroke, Parkinson's, depressive symptoms (previous year), or history of cancer of myocardial infarction.	No risk factors included.	Depressive symptoms in the previous year or a history of cancer or myocardial infarction, but not mentioning a time limit.	Not mentioned.	Not mentioned.	Depressive symptoms.	
Ekdahl E	2012	How to promote better care of elderly patients with multi-morbidity in Europe: A Swedish example	**Excluded: Theoretical article.**									D?
Findley	2011	Multimorbidity and persistent depression among veterans with diabetes, heart disease and hypertension.	N=1.383.950, Veterans health administration, 2001 and 2002, US, retrospective longitudinal study, no stated age limit.	2 or more conditions.	4 conditions. VHS administrative data and Medicare claims for veterans. Used ICD-9-CM.	Diabetes, heart disease and hypertension and depression.	Hypertension.	At least one inpatient visit or one or two outpatient visits with that condition as primary or secondary diagnosis.	Not mentioned.	Not mentioned.	No symptoms included.	R
Fitzgerald E	2010	An analysis of the interactions between individual comorbidities and their treatments--implications for guidelines and polypharmacy	**Excluded: No definition of MM.**									
Formiga	2013	Patterns of comorbidity and MM in the oldest old: The Octabaix study.	N=328, Barcelona, Spain. 85 years or older. Community-	2 or more chronic conditions.	16 most common conditions. Self-reports and clinical history. Interview in their	Hypertension, diabetes, dyslipidemia, ischemic cardiomyopathy,	Hypertension and dyslipidemia.	Chronic if permanent or caused by non-reversible pathological alterations.	Not mentioned.	Not mentioned.	Visual impairment.	X? D R

			dwelling. Cross-sectional.		homes by trained doctor or nurse. Geriatric assessment, collection of socio-demographic data, functional status (Barthel index and ADL), cognitive function (Mini-mental state examination).	heart failure, stroke, COPD, atrial fibrillation, peripheral arterial disease, Parkinson's disease, malignancy, dementia, anemia (hemoglobin less than 12), chronic kidney disease (GFR lower than 60), visual impairment (Jaeger charts) and deafness (whisper test).						
Fortin E	2004	Multimorbidity and quality of life in primary care: a systematic review.	**Excluded: systematic review.**									D
Fortin	2005	Prevalence of multimorbidity among adults seen in family practice.	N= 980 (330 men and 660 women), cohort study, general practice, 2002 Dec-2003 July, Quebec, Canada, aged 18 years and older.	Used various cut-offs.	Medical records (reviewed by nurses). CIRS-G (Miller et al): 14 anatomical domains, 0-4 for severity. Can get a score of max 56.Counted all chronic conditions "health problems that require ongoing management over a period of years or decades" found in the record, the conditions were putted in the different domains.	Heart (Atherosclerotic Heart Disease, Congestive Heart Failure, Arrhythmias, Valvular Disease, Pericardial Pathology), vascular (Hypertension, Peripheral Atherosclerotic Disease, Intracranial vascular event, Aortic Aneurysm), hematopoietic (Malignancy, Anemia, Leucopenia), respiratory (Smoking Status, Chronic Bronchitis, Asthma, and Emphysema, Pneumonia, eyes, ears, nose, throat and larynx (Impaired vision, Hearing Impairment, Vertigo, Lightheadedness and Dizziness ,	Hypertension, osteoporosis and obesity.	1). Cancer diagnosed in the remote past without evidence of recurrence or sequelae in the past 10 years. 2). Cancer diagnosed in the past without evidence of recurrence or sequelae in the past five years. 3). Required chemotherapy, radiation, hormonal therapy or surgical procedure for cancer in the past five years. 4). Recurrent malignancy of life threatening potential/failed containment of the primary malignancy/palliative treatment stage. (Miller et al.)	Organized in organ specific clusters.	Included in CIRS. 0 - No Problem, 1 - Current mild problem or past significant problem 2 - Moderate disability or morbidity/ requires "first line" therapy 3 - Severe/constant significant disability/ "uncontrollable" chronic problems 4 - Extremely Severe/immediate treatment required/end organ failure/severe impairment in function.	Smoking status, impaired vision, hearing impairment, vertigo, lightheadedness, dizziness, constipation, bleeding, vaginal bleeding, prostate problems and headaches.	RI

						Other conditions), upper GI (Ulcers, Cancer), lower GI (Constipation, Bleeding and Cancer, Diverticular Disease), liver (Gall bladder Disease, Hepatitis, Pancreatic Disease, Carcinoma), renal, genitourinary (Urinary incontinence, Vaginal bleeding and abnormal PAP smears, Urinary Infections, Prostate problems, Urinary Diversion Procedure), musculoskeletal/integument (Skin cancers, Arthritis, Osteoporosis, Osteomyelitis, and Cancer) neurological (Headaches, TIA's and Strokes, Vertigo, Dizziness and Lightheadedness, Neurodegenerative Disease, Dementia), endocrine and breast (Diabetes Mellitus, Hormone replacement /Electrolyte disturbance, Obesity, Breast Pathology, psychiatric disorder.						
Fortin	2005	Comparative assessment of three different indices of multimorbidity for studies on health related quality of life.	N=238, general practice (from the prevalence study Fortin 2005), Jan-July 2003, Quebec, Canada, aged 18 years and older, cross-sectional.	No spec. cut-off. Chronic conditions.	Medical records. All chronic conditions "health problems that require ongoing management over a period of years or decades" were extracted to score CIRS (14), Charlson	**CIRS**: cardiac, vascular, hematological, respiratory, ophthalmological/ORL, upper GI lower GI, hepatic/ pancreatic, renal, genitourinary, musculoskeletal/	**CIRS:** Not specified. **FCI:** Obesity (BMI > 30) and osteoporosis. **Charlson:** Not stated.	Not mentioned.	Not mentioned.	Not mentioned, but included in CIRS and Charlson.	**CIRS:** Not specified. **FCI:** Visual impairment, hearing impairments, and severe chronic back pain. **Charlson:**	RI

					index (19) and Functional comorbidity index (FCI) (18). For HRQoL SF-36 was used.	tegumental, neurological, endocrine/ metabolic/breast and psychiatric. **FCI:** arthritis (RA and osteoarthritis), osteoporosis, asthma, COPD/ARDS, angina, congestive heart failure or heart disease, heart attack, neurological disease, stroke/TIA, diabetes type 1 or 2, peripheral vascular disease, upper GI, depression, anxiety and panic disorders, visual impairment, hearing impairment, degenerative disk disease, obesity (BMI >30). **Charlson:** myocardial infarct, congestive heart failure, peripheral vascular disease, cerebrovascular disease, dementia, chronic pulmonary disease, connective tissue disease, ulcer disease, stroke and TIA, diabetes, hemiplegia, moderate or severe renal disease, diabetes with end organ damage, any tumor, leukemia, lymphoma, moderate or severe liver disease, metastatic solid tumor and AIDS.					Hemiplegia.	
Fortin E	2005	Multimorbidity is common to family practice: is it commonly researched?	**Excluded: No definition of multimorbidity.**									

Fortin	2006	Psychological distress and multimorbidity in primary care.	N=238, general practice (from the prevalence study Fortin 2005). Jan-July 2003, Quebec, Canada, aged 18 years and older, cross-sectional.	No spec. cut off. Chronic conditions.	Medical records, CIRS or simple count of diseases (chronic conditions). Nurse filled in CIRS. No number stated. The patients also filled in the IDPESQ14 which is an index for anxiety and depression. The latter data were collected from Nov 2003 to Feb 2004.	**CIRS**: cardiac, vascular, hematological, respiratory, ophthalmological/ORL, upper GI lower GI, hepatic/ pancreatic, renal, genitourinary, musculoskeletal/ tegumental, neurological, endocrine/ metabolic/breast and psychiatric.	Not specified.	Not mentioned.	Not mentioned.	Included in CIRS, rated 1-4.	Not specified.	
Fortin	2006	Relationship between multimorbidity and health-related quality of life of patients in primary care.	N=238, general practice (from the prevalence study Fortin 2005). Jan-July 2003, Quebec, Canada, aged 18 years and older, cross-sectional.	No spec cut-off. Chronic conditions.	Medical records, CIRS or simple count of diseases (chronic conditions "health problems that require ongoing management over a period of years or decades. No number stated. The patients also filled in the SF-36 questionnaire.	**CIRS**: cardiac, vascular, hematological, respiratory, ophthalmological/ORL, upper GI lower GI, hepatic/ pancreatic, renal, genitourinary, musculoskeletal/ tegumental, neurological, endocrine/ metabolic/breast and psychiatric.	Not specified.	Not mentioned.	Not mentioned.	Included in CIRS, rated 1-4.	Not specified.	D X
Fortin E	2006	Randomized controlled trials: do they have external validity for patients with multiple comorbidities?	**Excluded: co-morbidity.**									D
Fortin E	2007	Caring for body and soul: The importance of recognizing and managing psychological distress in persons with multimorbidity	**Excluded: Theoretical article.**									
Fortin	2007	Multimorbidity and quality of life: a closer look.	N=238, general practice (from the prevalence study Fortin 2005). Jan-July 2003, Quebec, Canada, aged	No spec. cut-off.	Medical records. CIRS 14 anatomical domains SF-36 to measure quality of life.	Cardiac, vascular, hematological, respiratory, ophtalmological-ORL, upper GI, lower GI, hepatic-pancreatic, renal,	Not mentioned.	Not mentioned.	Not mentioned.	Not mentioned, but included in CIRS, 0-4 rating of severity.	Not stated.	

			18 years and older, cross-sectional.			genitourinary, musculoskeletal-tegumental, neurological, endocrine-metabolic-breast and psychiatric.						
Fortin	2010	Prevalence estimates of MM: a comparative study of two sources.	N=26000 (2005) general population and N=980 (2003), general practice, 25 years and older, Quebec, Canada, cross-sectional.	2 and 3 or more chronic conditions.	7 diseases in general population randomly selected from a **register,** then underwent a 45-minutes **interview with self-reports** in 2005. Data from general practice: **medical records**, patients recruited in practice. Made one search restricted to the seven diseases and one with an open list of all chronic diseases that were found in the medical records.	Arthritis, cancer, diabetes, hypertension, heart disease, COPD and psychiatric problems.	Hypertension. Complications of diseases were considered as separate diseases when using the open list.	Not mentioned.	Not mentioned.	Not mentioned.	Psychiatric problems.	D R
Fortin E	2011	The electronic cumulative illness rating scale: A reliable and valid tool to assess multi-morbidity in primary care	**Excluded: No definition of MM.**									
Fortin E	2011	Canadian guidelines for clinical practice: an analysis of their quality and relevance to the care of adults with comorbidity.	**Excluded: No definition of MM.**									D
Fortin E	2012	A systematic review of prevalence studies on MM: toward a more uniform methodology	**Excluded: systematic review.**									D
France E	2012	Multimorbidity in primary care: a systematic review	**Excluded: systematic review.**									D

		of prospective cohort studies										
Freund	2012	Patterns of multimorbidity in primary care patients at high risk of future hospitalization	N=6026, primary care, Jan 2007- Dec 2008, Heidelberg, Germany, no age limit, retrospective cohort study.	2 or more chronic conditions.	33 chronic conditions, used in a large prospective cohort study by Schafer. Insurance claims data, included information from the past two years and all ICD-10 (both inpatient and outpatient), prior costs, hospital admissions and demographic data. Made a hierarchical clinical category (HCC). Then a prediction of LOH – which indicates the likelihood of at least 1 hospital admission within the next 12 months.	Hypertension, visual impairment, osteoarthritis, type 2 diabetes, coronary heart disease, depression, malignant disorder, thyroid disorder, chronic heart failure, neuropathy, cerebrovascular disease, osteoporosis, alcohol abuse, urinary incontinence, peripheral vascular disease, hearing loss, renal failure, RA, COPD, AF, somatoform disorder, anemia, valvular disorder, dementia, diabetes type 1, asthma, anxiety disorder, psoriasis, schizophrenia, drug abuse, Parkinson's disease, chronic hepatitis and AIDS.	Hypertension and osteoporosis.	Not mentioned, but they searched the claims data two years back in time.	Not mentioned.	Make Hierarchical clinical categories (HCC) where the most severe condition is reported.	Visual impairment, urinary incontinence, alcohol abuse, and drug abuse.	R
Fried E	2004	Untangling the concepts of disability, frailty, and comorbidity: implications for improved targeting and care	**Excluded: Theoretical article (also review).**									D!
Friedman	2006	Hospital inpatient costs for adults with multiple chronic conditions	N=no exact number > 2,000,000, aged 18 years and older, hospital patients, 2001, cross-sectional, US.	No spec. cut-off. Chronic conditions.	Self-reports and medical record. All chronic conditions (conditions that limit self-care, independent living and social interactions and has a need for ongoing intervention with medical products, services and special	Has 260 condition groups based on 14, 000 ICD-9-CM codes.	Disorders of lipid metabolism, hypertension, osteoporosis and obesity.	Not mentioned, but a chronic condition should last for 12 months or longer (Perrin et al 1993).	Diagnose categories in CCS.	Examine severity in all-payer reimbursement (APR), but do not state a criterion for severity.	Headache, conditions associated with dizziness or vertigo, nonspecific chest pain, genitourinary symptoms and ill-defined conditions, syncope, fever of unknown origin,	RI

					equipment) based on ICD-9-CM. Use Clinical Classification System (CCS) which has 260 categories to categorize all ICD-9-CM codes to a limited number of clinically meaningful categories.						lymphadenitis, nausea and vomiting, abdominal pain, malaise and fatigue, shock, melena, other esophageal bleeding, hemorrhage of rectum and anus, hematemesis , other back problems, lumbago, back ache, paralysis, hemiplegia, convulsions, vision defects, constipation and dysphagia, hematuria, retention of urine, other and unspecified genitourinary symptoms , female genital pain and other symptoms.	
Friedman	2012	Living well with medical comorbidities: a biopsychosocial perspective	N=998, national survey, US, data collection 1995-1996, 2004-2006 and 2004-2009, middle-aged and older, no exact age-limit, cohort study.	No spec cut off. Chronic conditions.	Telephone interviews and questionnaires. Clinical blood samples. **12 self-reported chronic conditions.** Also measure: IL-6 and CRP, eudaimonic well-being (purpose in life and positive relations with others), hedonic well-being (positive and negative affect), obesity, medication (antihypertensive, antidepressants and cholesterol-lowering medication), health behavior (smoking,	Autoimmune disorders, cardiovascular and cerebrovascular diseases, hypertension, arthritis, asthma, diabetes, GI diseases, liver disease and cancer. All conditions not stated.	Hypertension.	Not mentioned.	Not mentioned.	Not mentioned.	No symptoms included.	D? R

					exercise).							
Fuchs	2012	Prevalence and patterns of morbidity among adults in Germany.	N=21,262, July 2008 to June 2009, Germany, cross-sectional, representative sample of the German population, aged 18 years and older.	2 or more chronic conditions.	Telephone interview, self-reports. **18 diagnoses** divided in 9 groups. When calculating multimorbidity: if more than one condition from one group the group is only counted once.	**Cardio metabolic:** Hypertension, hypercholesterolemia, diabetes, obesity (BMI>30), **cardiovascular:** myocardial infarction, angina pectoris, or any other coronary heart disease, chronic heart failure, stroke, **lower respiratory disease:** asthma, chronic bronchitis, **liver/renal diseases:** chronic liver disease, chronic renal disease, **upper gastric disease:** gastritis, gastric ulcer, **musculoskeletal disease:** osteoarthritis, RA, osteoporosis (only those aged over 50 years), chronic back pain, **cancer:** lifetime medical history of any type of cancer, **depression** and severe sensory **limitations:** severe hearing or visual impairment.	Hypertension, hypercholesterolemia and obesity (BMI>30) and osteoporosis (only those aged over 50 years).	Ever told by a physician and present the last 12 months. Lifetime medical history of any type of cancer. Chronic back pain at least 3 months the last 12 months.	Not mentioned more than the groups the diagnoses are divided in.	Not mentioned.	Severe hearing or visual impairment and chronic back pain.	X D R
Fung	2008	The relationship between multimorbidity and patients' ratings of communication	N=15709, cross-sectional, US, Feb 2001-Sept 2002, national sample, from the Community Quality Index (CQI), no age limit; medium age 45.8 years.	Not a spec cut-off. 0, 1-2 and 3 or more. Chronic conditions.	Telephone-interview, self-reported "has a doctor ever told you?", **16 chronic conditions**. Both count of individual conditions and condition groups (concordant conditions), also 0, 1-2 and 3 or more.	COPD, symptomatic asthma, chronic headache, diabetes, hypertension, hyperlipidemia, heart failure, coronary artery disease, uterine bleeding, benign prostate hyperplasia, cataracts, osteoarthritis, cancer, obesity,	Hypertension, hyperlipidemia and obesity.	Not mentioned.	Made "count of condition groups" with concordant conditions e.g. CVD, diabetes and obesity, endocrine: diabetes and obesity, etc.	Not measured.	Chronic headache and uterine bleeding and alcohol misuse.	D X? R

						alcohol misuse and depression and other mental health condition.						
Galenkamp	2011	Somatic multimorbidity and self-rated health in the older population	N=2046, Amsterdam, The Netherlands, 57-98 years old, general older population, Data collected on different times 1992, 2001/2002 and 2005, cohort study.	No spec cut-off 1, 2, 3 and 4 chronic diseases.	Population registers and questionnaires. Asked about **7 chronic conditions** + report of a maximum of two other diseases not mentioned. Self-rated health was assessed by asking: How is your health in general?	Chronic lung disease (asthma, chronic bronchitis, emphysema), cardiac disease, peripheral atherosclerosis, stroke, diabetes mellitus, arthritis (RA and osteoarthritis) and cancer.	No risk factors included.	For the two extra diseases they should have been present for three months or longer and should have been treated and examined by a physician.	Not mentioned.	Not mentioned.	No symptoms included.	X
Gamma E	2001	Concurrent psychiatric comorbidity and multimorbidity in a community study: gender differences and quality of life	**Excluded: No definition of MM.**									
Garcia-Olmos	2012	Comorbidity patterns in patients with chronic diseases in general practice	N=198.670, Madrid, Spain, 2007, general practice, aged 14 years and older, cross-sectional.	2 or more chronic conditions.	Initial selection of 40 chronic EDC; when taking prevalence and impact on health service into account they ended with 26. Do not state in the methods section explicitly what diseases. Medical records, all diagnoses for which they had visited a doctor in 2007. Patients were classified according to Adjusted Clinical Groups (ACG) Case-Mix System. Can also generate Expanded Diagnosis Clusters which group patients on the basis of clinical criteria.	In the result section they are stated as follows: hypertension, hyperlipidemia, diabetes (type 2), cardiac arrhythmia, cerebrovascular disease, ischemic heart disease, chronic renal failure, heart failure, anxiety and depression, thyroid disease, asthma, schizophrenia and affective psychoses, obesity, osteoporosis, deafness or hearing loss, malignant neoplasms, degenerative joint disease, benign prostatic hypertrophy, emphysema or bronchitis or COPD,	Hypertension, hyperlipidemia, osteoporosis and obesity.	Not mentioned.	Not mentioned in forehand.	Not mentioned.	Not included.	X D RI

						generalized atherosclerosis, glaucoma, chronic liver disease, dementia and delusions, chronic skin ulcer, cardiac valve disease and Parkinson's disease.						
Gilbert E	2011	Ageing well: Improving the management of patients with multiple chronic health problems	**Excluded: Review (also qualitative).**									D?
Giovannetti E	2012	Difficulty assisting with health care tasks among caregivers of multimorbid older adults	**Excluded: No definition of MM.**									
Glynn	2011	The prevalence of multimorbidity in primary care and its effect on health care utilization and cost	N=3309, primary care, aged > 50 years, West of Ireland, around 2009, observational study.	2 or more chronic conditions.	Patient records ICPC-2 (consultation notes and correspondence from other health care professionals), counted chronic conditions (147 of 686 are chronic conditions) according to WHOs definition of a chronic condition "health problems that require ongoing management over a period of years or decades".	147 conditions listed in supplementary data.	Hypertension (complicated and uncomplicated), obesity, overweight, osteoporosis and lipid disorder.	Not mentioned.	Not mentioned.	Not mentioned.	Chronic alcohol abuse.	D R
Grimby	1997	Morbidity and health-related quality of life among ambulant elderly citizens	N=565, Sweden, aged 76-years old, general population living in their homes, cross-sectional, not stated time for selecting data.	No spec. cut-off.	Medical records, register and physician's examination. 16 conditions.	Cancer (reported in Swedish cancer registry in the age interval 65-76 years), hypertension (ongoing treatment), stroke/paresis (history), myocardial infarction (history), angina pain (defined according to Rose),	Hypertension.	Knee joint disorders (symptoms for more than 6 months), hip joint disorders (symptoms for more than 6 months), and upper extremity disorders (symptoms in shoulder, elbow, wrist and/or finger joints for more than 6 months).	Not mentioned.	Not mentioned.	Mental disorders (self-perceived symptoms or treatment), hearing impairment, visual impairment, urinary incontinence, and back pain.	R

						intermittent claudicatio, lung disease (on treatment for asthma/chronic bronchitis), diabetes (ongoing treatment with diet and/or oral drugs or insulin; repeated fasting glucose levels >8.3mmol/L), urinary incontinence, knee joint disorders (symptoms for more than 6 months), hip joint disorders (symptoms for more than 6 months), upper extremity disorders (symptoms in shoulder, elbow, wrist and/or finger joints for more than 6 months), back pain (every day or every week), mental disorders (self-perceived symptoms or treatment), hearing impairment, visual impairment, and locomotor disorders.						
Gulbech-Ording E	2013	Concepts of comorbidities, multiple morbidities, complications, and their clinical epidemiologic analogs	**Excluded: Theoretical article.**									D
Gunn	2012	The association between chronic illness, multimorbidity and depressive symptoms in an Australian primary care	N=7620, general practice, Australia, cross-sectional, aged 18-76 years, date for collection not	No spec cut-off, both2, 3, 4 and 5+ conditions. Chronic conditions.	Screening questionnaire with depression scale and 12 common chronic physical conditions.	Asthma, emphysema or other chronic lung problem, diabetes (high blood sugar), arthritis or any kind of rheumatism, back problems, chronic	Hypertension and lipid disorder.	Experienced the disease in the last 12 months.	Not more than divide the conditions in organ systems: cardiovascular system: stroke, heart disease, lipid disorder and	Rated their health as: Excellent, very good, good fair and poor. Severity otherwise not stated.	Back pain.	D X R

		cohort.	stated.			back pain or sciatica, hypertension, chronic sinusitis, lipid disorder (high cholesterol), heart disease (angina, heart failure, heart attack), cancer (except non-melanoma skin cancer) stroke and dermatitis.			hypertension. Musculoskeletal: back problems and arthritis. Conditions related to respiratory system: emphysema, chronic sinusitis and asthma. Conditions related to the endocrine system: skin and diabetes.			
Haggerty	2010	At the interface of community and healthcare systems: a longitudinal cohort study on evolving health and the impact of primary healthcare from the patient's perspective	N=2000, study protocol, Quebec, aged 25-75 years old, cohort study, patients are randomly selected among geographic boundaries of four local health care networks.	>10 if minimal impact diseases and 2 or more if major impact.	Questionnaire. For 22 mental or physical conditions diagnosed by a health professional the patient is supposed to report the interference with daily activities. But not stated if more conditions will be included in the study. Will use the Disease Burden Morbidity Assessment. Recruited trough telephone-survey.	Hypertension, elevated cholesterol, asthma, pulmonary problem, diabetes, thyroid disorder, osteoarthritis, rheumatoid arthritis, back pain or sciatic pain, osteoporosis, other illness that affects the members or the articulations, reflux, peptic ulcer or pyrosis, intestine problem, overweight, hearing problem, vision problem, cardiac illnesses, CVA, heart failure, cancer (past 5 years), depression or anxiety problems, other chronic health problem not mentioned above.	Hypertension, osteoporosis and overweight.	For cancer the past 5 years.	Not mentioned.	Should report the interference with daily activities.	Pulmonary problem, back pain, intestine problem, hearing problem, pyrosis and vision problem.	R
Hardt E	2003	Long-term evaluation of geriatric treatment: Results of a prospective study (Part 4: Patients with functional impairment associated with multimorbidity)	**Excluded: No definition of MM.**									
Haregu E	2012	Perspectives,	**Excluded:**									D?

		constructs and methods in the measurement of multimorbidity and comorbidity: A critical review.	**Review.**									
Harrison	2013	Prevalence of chronic conditions in Australia.	N=8707, July 2008 - May 2009, Australia, general practice and general population, no age limit, cross-sectional.	Not spec. cut-off. Chronic conditions.	24 disorders, in 9 systems. 3 subgroups of patients from the BEACH program where a random sample of GP's record information on their patients. **GP's fill in a questionnaire** with chronic conditions on the base of their knowledge of the patients and health records, then the patients are divided in three groups: 1. Patients seeing their GP (found in waiting room) called sample population. 2. General practice patient population. 3. Population.	Cardiovascular: hypertension, ischemic heart disease, congestive heart failure, peripheral vascular disease, CVA/stroke, other; endocrine/nutritional: hyperlipidemia, diabetes type 1, diabetes type 2, obesity (BMI >30), other; musculoskeletal; osteoarthritis, RA, other arthritis, osteoporosis, chronic back pain, other; respiratory; asthma, COPD, other; psychological; depression, anxiety, sleep disorder, other; GI; GORD (gastro-oesophageal reflux disease), IBD, other; genitourinary; chronic renal failure, other; eye; glaucoma, other; other chronic problems; malignant neoplasm, other disease.	Hypertension, hyperlipidemia, osteoporosis and obesity.	Not mentioned.	Divided diseases in subgroups in the questionnaire. Otherwise not.	BMI over 30. Otherwise no severity.	Chronic back pain and sleep disorder.	R
Hengstermann E	2009	Total serum homocysteine levels do not identify cognitive dysfunction in multimorbid elderly patients	**Excluded: No definition of MM.**									
Henning	2012	Higher medical morbidity burden	N=3212, North Carolina,	No spec cut-off.	Interviews. 9 conditions.	Heart attack or myocardial	Hypertension and obesity.	Not mentioned.	Not mentioned.	Morbidity burden was	Hearing and visual impairment.	D R

er		is associated with external locus of control	US. Data set from the older population (the North Carolina Established population for Epidemiologic Studies of the Elderly) collected 1986-1997, but they used data collected 1989/1990, aged 65 years and older, cohort study.		Obesity measured as BMI over 30, self-reported height and weight. Persons who could not hear without seeing the person that speaks was classified as having hearing impairment. Problems with reading newspapers even with best correction or inability to recognize a friend across the street – visual impairment. The other disease – has a physician ever told you? Also collected information on ADL, IADL and Rosow-Breslau Mobility Scale (ability to perform heavy work). Also depressive symptoms with CES-D and cognitive function with Short Portable Mental Status Questionnaire. LOC eight item questionnaire.	infarction, stroke, diabetes, high blood pressure, obesity, cancer, arthritis, hearing and vision impairment.				calculated by summarizing the nine medical conditions.		
Heyworth	2009	How do common chronic conditions affect health-related quality of life?	N=5169, Aged >16 years, Manchester, UK, 2004, general practice, cross-sectional.	No spec-cut off.	Medical records, formal register or Read codes (GP). 6 conditions. Also, questionnaire about respiratory problems and general health (EQ-5D).	Asthma, COPD, ischemic heart disease, hypertensive disease, diabetes, and cerebrovascular disease.	Only hypertensive disease (mention hypertension in the result section), but that is probably not just a risk factor.	Not mentioned.	Not mentioned.	Not mentioned.	No symptoms included.	
Higashi	2007	Relationship between number of medical conditions and	N=7680, US Three studies: 1. The Community	No cut-off. Chronic conditions.	Do not state a number of conditions they investigate.	Conditions the same across all three studies: Depression,	Hypertension and osteoporosis.	Selected conditions that require continuous management.	Not mentioned.	Not mentioned.	Urinary incontinence and dyspepsia.	R

		quality of care	Quality Index (CQI): Oct 1998-Aug2000, no age stated, general population. 2. ACOVE: aged 65 years and older, Oct 1999-Jan 2000, community-dwelling. VHA: 35 years and older, male veterans, Oct 1997-Sept 1999. Cross-sectional.		Selected conditions that require continuous management do not state more and then report the most common conditions in the three studies. CQI: telephone interview regarding medical care experiences two years before the interview and medical records. ACOVE: telephone interview. VHA: not stated clearly, probably database. Used quality indicators to measure quality of care.	diabetes, heart failure, stroke, hypertension, coronary artery disease, osteoarthritis, COPD and atrial fibrillation. For ACOVE: dementia, pressure ulcer, osteoporosis, urinary incontinence, and renal insufficiency. For CQI and VHA: benign prostatic hypertrophy, dyspepsia, asthma, colorectal cancer and prostate cancer. CQI: breast cancer.						
Holden	2011	Patterns of multimorbidity in working Australians.	N=78430, cross-sectional. Oct 2004 to Dec 2005, Australia. Employees of 58 large companies were invited to the study. Included 18-70 years old.	Says in the introduction MM 2 or more chronic conditions and that they will use this definition.	Used The Health and Productivity Questionnaire (HPQ) for self-report of 22 health conditions. And The Kessler 6 for psychological distress.	Arthritis, asthma, back/neck pain, cancers (excl skin cancer), skin cancers, COPD (both chronic bronchitis and emphysema), CVD, psychological distress, drug and alcohol problems, diabetes, fatigue (incl sleeping problems), high blood pressure, high cholesterol, injury (work related), migraine, obesity, bladder problems, heart burn, irritable bowel disorder, ulcers, osteoporosis or other chronic pain.	High blood pressure, high cholesterol, osteoporosis and obesity.	Not stated.	Not stated in the methods section.	Not stated.	Back/neck pain, fatigue, bladder problems, heart burn, psychological distress, drug and alcohol problems and other chronic pain.	R
Holzhausen	2011	Operationalizing multimorbidity and autonomy for health services research in aging populations--the	Study protocol. N=248 (Berlin OMAHA cohort) and N=593 (German OMAHA	No spec cut-off.	Self-reported physician diagnosed conditions, history of surgical procedures,	The physician diagnosed conditions are not mentioned specifically just state the number 31	Not mentioned specifically.	Fractures after the age of 50, medication use the previous 7 days, weight loss (past 12 months), height loss (since age	Not mentioned.	Not mentioned.	Visual and hearing problems, urinary and fecal incontinence, constipation, back pain and joint	

		OMAHA study	cohort), Germany, cohort study, general population.		fractures after the age of 50, medication use the previous 7 days, height, weight, waist and calf circumference and blood pressure. Also self-reported symptoms, in total **31 conditions**. Also information on falls, operations and health service utilization. Also tests for physical functioning and neuropsychological function, disability, ADL and quality of life.	conditions.		of 25), falls (the past 12 months and 4 weeks).			complaints, weight loss (past 12 months), height loss (since age of 25), falls (the past 12 months and 4 weeks).	
Hudon E	2005	Cumulative Illness Rating Scale was a reliable and valid index in a family practice context	**Excluded: No def of MM.**									
Hudon	2008	Relationship between multimorbidity and physical activity: secondary analysis from the Quebec health survey	N=16782, Quebec, Canada, general population, aged 18-69 years, 1998, cross-sectional.	Two ways: 1. 0 as reference and then 1, 2, 3, 4 and 5 or more. 2. 2 or more.	One questionnaire administered by an interviewer and one self-administered (purpose to collect data from the Quebec population on health status and well-being). 1. Self-reported from a list of 25 conditions. 2. from a list by Kaplan et al. 10 conditions.	1. anemia, dermatologic disease, allergies, back disease, arthritis, serious articular, muscular or tendinous condition, cancer, diabetes, pulmonary condition, mental deficiency, depression, anxiety, psychosis, epilepsy, hypertension, cardiac disease, renal disease, ulcer or other gastric problem, thyroid disease, frequent headache, stroke sequelae, cognitive deficit, obesity and ocular disease. 2. Asthma, arthritis or rheumatism, back disease, hypertension,	Hypertension and obesity.	Not mentioned.	Not mentioned.	Not mentioned.	Frequent headache, gastric problem.	R

						chronic bronchitis or emphysema, diabetes, cardiac disease, stroke sequelae, cognitive deficit and ocular disease.						
Hudon	2012	The relationship between literacy and multimorbidity in a primary care setting	N=301, Quebec, Canada, 18 years and older, general practice, cross-sectional, not stated time point.	No spec cut-off.	Self-reports. Literacy measured with: Newest Vital Sign (NVS). MM measured with: Disease Burden morbidity assessment (DBMA) (developed by Bayliss et al. with 21 conditions) in this study they use 11 conditions with high prevalence in their clinic. Every condition is rated 1-5 according to effects of daily life. They also measure MM by taking 6 of the conditions considered to be ass with lifestyle habits.	Hypertension, hyperlipidemia, asthma, COPD, diabetes, osteoarthritis, back pain, other musculoskeletal conditions, overweight, angina/coronary artery disease and heart failure. For the second measure: Hypertension, hyperlipidemia, diabetes, overweight, angina/coronary artery disease and heart failure.	Hypertension, hyperlipidemia, and overweight.	Not mentioned.	Not mentioned, though they select conditions related to lifestyle in one measure.	Every condition is rated 1 (not at all to 5 a lot) according to effects of daily life.	Back pain.	X R
Hughes E	2013	Guidelines for people not for diseases: the challenges of applying UK clinical guidelines to people with multimorbidity	**Excluded: No definition of MM.**									
Hunger	2011	Multimorbidity and health-related quality of life in the older population: Results from the German KORA-Age study	N=4565, Germany, aged 65 years and older, Nov 2008-Sept 2009, population-based, cross-sectional.	No spec cut-off.	Self-reports, 6 conditions. Also BMI. ED-5D to measure HRQL.	Stroke (ever had, also the year of the stroke), myocardial infarction (ever had, year, also by-pass operation), cancer (ever had, year), diabetes (ever told by a physician), hypertension (ever told), chronic bronchitis (cough and sputum for	Hypertension.	Not stated more than in the history "ever had" or three months sputum for chronic bronchitis.	Not mentioned.	Not mentioned.	No symptoms included other than cough and sputum for three months pointing at chronic bronchitis.	R

						most days in three consecutive months).						
Huntley E	2012	Measures of multimorbidity and morbidity burden for use in primary care and community settings: a systematic review and guide	**Excluded: Systematic review.**									
Härter	2007	Increased 12-month prevalence rates of mental disorders in patients with chronic somatic diseases.	N=2310 (patient group) and N=1083 (healthy control group), Germany, two studies GHS-MHS (general population) and EMDMR (inpatient rehabilitation centers), not stated what year the examination was performed, no stated age limit.	Not a spec cut-off.	4 conditions. GHS-MHS: somatic examination, self-report questionnaire and structured interview. EMDMR: admission reports, laboratory data and complete physical examination.	Cancer, musculoskeletal disorders, cardiovascular and respiratory tract diseases.	No risk factors.	GHS-MHS: Present within the previous 12 months.	Not mentioned.	Not mentioned.	No symptoms included.	
Jacobs E	2013	Polypharmacy, multimorbidity and the value of integrative medicine in public health	**Excluded: Theoretical article.**									
Jakovljevic E	2009	Psychopharmacotherapy and comorbidity: conceptual and epistemiological issues, dilemmas and controversies	**Excluded: Theoretical article, focusing mainly on psychiatry.**									
Jakovljevic E	2010	Comorbidity, multimorbidity and personalized psychosomatic medicine: epigenetics rolling on the horizon	**Excluded: Theoretical article, focusing mainly on psychiatry.**									
John E	2003	Patterns and impact of	**Excluded: Co-morbidity.**									

		comorbidity and multimorbidity among community-resident American Indian elders										
Junius-Walker E	2010	Health and treatment priorities in patients with multimorbidity: report on a workshop from the European General Practice Network meeting 'Research on multimorbidity in general practice'	**Excluded: Theoretical article.**									D
Kadam Not sure that I have all sympto ms cannot reach the source and most of the sources inlcuded do not tell.	2007	Clinical multimorbidity and physical function in older adults: a record and health status linkage study in general practice.	N=9439, cross-sectional, Staffordshire, UK, aged 50 years and older, general practice, 18 months study period, not stated when.	To definitions: First: Simple count of consultation s for different morbidities, single morbidity only (reference), 2-3: low count, 4-5: medium and 6 or more: high. Second: based on combinatio ns of 185 selected morbidities classified by severity.	Self-reported physical function: physical component score (PCS). Used Read system to code all morbidities in an actual consultations for 18 months. Are grouped in 19 main Read chapters, with four levels. They used three of them here. A condition was only calculated once in the 18 months. First way: If 1 condition: single morbidity only, 2-3 low count, 4-5 medium and 6 or more high. Second way: 185 conditions classified by severity. Classified by GP's by; chronicity (acute, acute-on-chronic, etc), time course (on-off, recurrent, permanent, etc.), health care use	Do not state what conditions refer to Harding et al. Harding does not state specific conditions.	Obesity and high blood pressure.	Mention time course as severity. Time course: on-off, recurrent, permanent and progressive.	Not mentioned.	Severity measured as: chronicity (acute, acute-on-chronic, etc), time course (on-off, recurrent, permanent, etc.), health care use (low, medium, or high) and patient impact (low, medium and high).	Sore throat, constipation (functional), pruritus and back pain, anxiety states.	D R

					(low, medium, high) and patient impact (low, medium and high). Each of the four scales was used separately.							
Kadam	2009	Does age modify the relationship between morbidity severity and physical health in English and Dutch family practice populations?	N=7833 from UK aged over 50 years (2001) and N=6846 from The Netherlands aged over 18 years (2001). Cross-sectional. General practice.	Not spec cut-off.	78 diagnoses. Medical records. Also SF-12 for physical health. ICPC in The Netherlands and Read codes in UK. **NB does not list all the conditions only states the number and the most prevalent.**	They are not stating all conditions, but these are the 5 most prevalent in each group: **acute UK**: bronchitis, upper resp infection, ear wax, UTI and conjunctivitis. **Acute (Dutch over 50)**: UTI, dermatophytosis, ear wax, bronchitis and sinusitis. **Acute (Dutch 18-49 years**): Dermatophytosis of foot, sinusitis, UTI, ear wax and bronchitis. **Acute-on-chronic (UK**): asthma, anxiety states, oesophagitis, allergic rhinitis, gouty arthropathy; **Acute-on-chronic (Dutch over 50)**: lumbosacral root leisons, asthma, oesophagitis, allergic rhinitis, gouty arthropathy; **Acute-on-chronic (Dutch 18-49**): allergic rhinitis, asthma, lumbosacral root leisons, anxiety states and hemorrhoids; **Chronic (UK)**: high blood pressure, generalized osteoarthritis, diabetes, hypercholesterolemia, hypothyroidism;	High blood pressure, hypercholesterolemia and obesity.	Not mentioned.	Not mentioned.	Defining morbidities in: 1. Acute (46 conditions)(last for days), 2. Acute-on chronic (11) (exacerbation of chronic illness), 3. Chronic (21) (months to years) or 4. Multimorbid combinations of any two categories: (acute and acute-on-chronic, acute and chronic or acute-on-chronic and chronic) or 5. Multimorbid combination of all three categories.	Anxiety states.	D? R

						Chronic (Dutch over 50): high blood pressure, diabetes, hypercholesterolemia, emphysema, hypertensive heart disease; **chronic (Dutch 18-49)**: high blood pressure, hypercholesterolemia, diabetes, RA and obesity.						
Kadam E	2013	Chronic disease MM transitions across health care interfaces and associated costs: a clinical-linkage database study.	**Excluded: Co-morbidity.**									
Kahn E	2007	Facilitating quality improvement in physician management of comorbid chronic disease in an urban minority practice	**Excluded: Co-morbidity**.									D?
Khanam	2011	Prevalence and patterns of multimorbidity among elderly people in rural Bangladesh: a cross-sectional study	N=452, July 2003-March 2004, Matlab, Bangladesh, general population, aged 60 years or older, cross-sectional study, collaboration between KI, Sweden and International Centre for Diarrhoeal Research, Bangladesh.	2 or more chronic conditions.	9 conditions. Interview and surveillance database for literacy and socioeconomic status, diagnoses were collected by two physicians and double checked by two geriatricians separately.	Arthritis, stroke, obesity (>27.5), signs of thyroid hypofunction, obstructive pulmonary symptoms, symptoms of heart failure, impaired vision, hearing impairment, and high blood pressure (>140/90).	Obesity and high blood pressure.	Not mentioned.	Not mentioned.	Not mentioned.	Symptoms of heart failure, obstructive pulmonary symptoms, hearing impairment, impaired vision and signs of thyroid hypofunction.	R
Kim	2012	Impaired Health-Related Quality of Life in Elderly Women is associated with MM: Results from the Korean national health	N=1419, Seoul, South Korea, Cross-sectional. Assessment of health and nutritional status of non-	No spec cut-off.	Interview survey, nutrition survey and examination survey. 20 conditions. Measured: Blood pressure, fasting blood sample;	Hypertension, hypercholesterolemia, diabetes, obesity, anemia, chronic kidney disease, arthritis, back pain, cataract or glaucoma,	Hypertension, hypercholesterolemia, osteoporosis and obesity.	Not mentioned.	Not mentioned.	Not mentioned.	Back pain and urinary incontinence.	R

		and nutrition examination survey.	institutionalized civilians, 2008, Jan-Dec.		glucose, cholesterol, hemoglobin, GFR, triglycerides and BMI. The other diseases were diagnosed by asking: has a doctor ever told you that you have..? QoL measured with: EQ-5D and EQ-VAS.	respiratory disease, osteoporosis, depression, urinary incontinence, pulmonary tuberculosis, peptic ulcer, stroke, ischemic heart disease, cancer, thyroid disease and liver disease.						
Kirchberger	2012	Patterns of multimorbidity in the aged population. Results from the KORA-Age study	N=4127, Germany, population-based, aged 65-94 years, 2008-2009, cross-sectional.	2 or more conditions.	13 conditions included. Questionnaire and a telephone interview.	Hypertension, stroke, diabetes mellitus, malignancy, lung (asthma, emphysema or COPD), joint (arthritis or RA), GI disease (gastric or duodenal ulcer, colitis, cholecystitis), heart disease (angina pectoris, heart failure, coronary heart disease, myocardial infarction (also indicate if ever went through coronary artery bypass graft surgery or received a coronary artery stent)), kidney disease, liver disease (cirrhosis), neurologic (MS, Parkinson's or epilepsy), eye disease (glaucoma, cataract, macular degeneration, diabetic retinopathy, and retinitis pigmentosa), mental (depression and anxiety).	Hypertension.	Not mentioned.	Not mentioned in the methods.	Not mentioned.	No symptoms.	R
Koller E	2012	Competing risks and the clinical community:	**Excluded: Review.**									

		irrelevance or ignorance?										
Kuo	2013	The influence of socio-economic status and MM patterns on health care costs: a six-year follow up under a universal healthcare system. Cohort.	N=903 376, Jan 2005-Dec 2010, Taiwan, general population, National Health Insurance Database, no stated age limit, cohort study.	2 or more numbers of Rx-MGs for each patient each year.	**Medication-based Rx-defined morbidity groups (Rx-MGs) within the Johns Hopkins Adjusted Clinical Groups (ACG).** Every medication is put into 1 of 64 Rx-MGs according to one of the following criteria: primary anatomicophysiological system, morbidity differentiation, expected duration and severity. Nine of the 64 Rx-MGs are used for minor or acute symptoms and were therefore excluded.	Not stated what conditions.	Not stated what risk factors are included.	Not mentioned.	Not mentioned.	Not mentioned.	Medication for general signs and symptoms are included.	
Laan	2013	Factors associated with increasing functional decline in multimorbid independently living older people	N=1187, aged 60 years and older, The Netherlands, cross-sectional, community-dwelling frail elderly, Jan 2006-March 2011 (healthcare consumption collected).	MM defined as chronically use of five or more different drugs, if taking it included in the study.	4 years prior to the study the diagnoses were collected and divided into 17 groups of common disorders in older patients serving as the measure of MM. But these conditions are just a collection of diagnoses in the database, not a decision taken in advance to defining MM. Also measured level of independence in ADL with KATZ-16 scale.	Not specified in advance but they select: Arthritis and arthrosis, BPH, benign tumors, cardiac problems, cataract, COPD and asthma, dementia, diabetes, hearing difficulties, hip fractures, kidney problems, malign tumors/cancer, osteoporosis, Parkinson's disease, psychiatric disorders, TIA and CVA and vision disorders.	Not specified in advance but include osteoporosis.	Looked for diagnoses 4 years prior to the study.	Not mentioned.	Not mentioned.	Not mentioned prior to the study. But they select cardiac problems and hearing difficulties.	D? R
Landi	2010	Disability, more than multimorbidity, was predictive of mortality among older persons aged 80 years and	N=364, prospective cohort study (4 years follow-up), Italy, 80 years and older.	2 or more chronic conditions.	Self-reports and medical record review. 13 chronic conditions. Also ADL, drugs received, BMI, lifestyle, family	Obesity, coronary heart disease, cerebrovascular disease, congestive heart failure, peripheral artery disease,	Obesity and hypertension.	Not mentioned.	Not mentioned.	Not mentioned.	No symptoms included.	D R

		older	All persons living in the Sirente area in Oct 2003, and born before 1st Jan 1924. Assessments Dec 2003-Sept 2004.		history, etc.	hypertension, lung disease (COPD, emphysema, or asthma), osteoarthritis, diabetes, dementia (Alzheimer's disease and other dementia), Parkinson's disease, renal failure, and cancer (not skin cancer).						
Langan E	2013	Multimorbidity and mental health: Can psychiatry rise to the challenge?	**Excluded: Editorial.**									
Lappens chaar E	2012	Probabilistic Causal Models of MM Concepts	**Excluded: Theoretical article.**									D
Latour E	2007	A method to provide integrated care for complex medically ill patients: The INTERMED	**Excluded: No definition of MM.**									
Laux	2008	Co- and multimorbidity patterns in primary care based on episodes of care: results from the German CONTENT project	N=39,699, Germany, primary care, 1 Jan-31 Dec 2006, no age limit.	No spec cut off. Chronic conditions.	Medical database ICPC diagnoses and medical procedures (prescriptions and referrals). Chronic condition defined after O'Halloran et al. that includes diagnoses and some chronic symptoms and complaints. Does not state a number of conditions but O'Halloran classifies 147 as chronic.	Not stated in the article but O'Halloran has 147 from 16 chapters in ICPC.	Hypertension (complicated and uncomplicated) , obesity, overweight, osteoporosis and lipid disorder.	Chronic condition defined after O'Halloran et al.'s definition.	Not mentioned.	Not mentioned.	Chronic alcohol abuse.	R
Lawson	2013	Double trouble: the impact of MM and deprivation on preference-weighted health related quality of life a cross sectional analysis	N=7054, Cross-sectional, Scotland, UK, general population, 20 years and older, 2003.	2 or more conditions from different systems of the body. Also acute.	Self-reports, The Scottish Health Survey (periodic cross-sectional survey on health and health behaviors in Scotland, estimate	1. Neoplasms and benign growths: cancer (including lumps, masses, tumors and growths). 2. Endocrine and metabolic: diabetes	Hypertension.	Just mention long standing: Something that bothered for a period of time and likely to affect over a period of time.	Grouped in 15 body systems.	Not mentioned.	Fits, convulsions, headaches, poor eyesight, poor hearing, noise in the ear, ear complaints causing balance problems,	R

		of the Scottish Health Survey.			of the general population). 40 conditions (ICD-10) (individuals can report up to six) divided in 15 systems of the body. SF-12. SF-6D algorithm was used to calculate PW_HRQoL (Preference Weighted).	(incl. hyperglycemia), other endocrine/metaboli c. 3: Mental illness: anxiety/depression/ nerves or mental handicap. 4. Nervous system: epilepsy/fits/convul sions, migraine/headaches , other problems of nervous system. 5. Eye complaints: cataract/poor eyesight/blindness, other eye complaints. 6. Ear complaints: Poor hearing/deafness, tinnitus/noise in the ear, Meniere's disease/ear complaints causing balance problem, other ear complaints. 7. Heart and circulatory system: Stroke/cerebral haemorrhage/cereb ral thrombosis, heart attack/angina, hypertension, other heart problems, piles/haemorrhoids incl varicose veins in anus, varicose veins/phlebitis in lower extremities, other blood vessels/embolic. 8. Respiratory system: Bronchitis/emphyse ma, asthma, hayfever, other respiratory complaints. 9. Digestive system: Stomach ulcer/ulcer/abdomi nal hemia/rupture,					complaints of bowel/colon (e.g. large intestine, caecum, bowel), complaints of teeth/mouth, tongue, kidney complaints, other bladder problems/inconti nence, back problems and skin complaints.	

						other digestive complaints (e.g. stomach, liver, pancreas), complaints of bowel/colon (e.g. large intestine, caecum, bowel), complaints of teeth/mouth, tongue. 10. Genitor-urinary system: kidney complaints, UTI, other bladder problems/incontinence, reproductive system disorders. 11. Musculoskeletal system: Arthritis/rheumatism/fibrositis, back problems/slipped disc. Spine/neck, other problems of bones/joints/muscles. 12. Infectious diseases: infection and parasitic diseases. 13. Disorders of blood and blood forming organs. 14. Skin complaints and 15. Other complaints.						
Le Reste E	2013	The European General Practice Research Network Presents a Comprehensive Definition of MM in Family Medicine and Long Term Care, Following a Systematic Review of Relevant Literature	**Excluded: Systematic review.**									D
Lee	2007	Mortality rate in veterans with multiple chronic conditions	N=741,847, Cohort study, Oct 1999-Sept 2000, aged 55-64 years,	1 or more chronic condition to be included. But check	Database for Veterans Affairs (VA) (inpatient, outpatient and mortality rates). 11	COPD, diabetes, hypertension, RA, osteoarthritis, asthma, depression, ischemic heart	Hypertension.	Just the diagnostic code appearing at least once in the 1-year time period.	Created groups (mutually exclusive) with two conditions in each.	Not mentioned.	No symptoms included.	X R

			veterans database, US.	clusters of 0, 1, 2, 3, and 4 or more.	conditions, ICD-9 codes.	disease, dementia, stroke, and cancer.						
Lehnert E	2011	Review: Health care utilization and costs of elderly persons with multiple chronic conditions	**Excluded: review.**									D?
Longman	2012	Frequent hospital admission of older people with chronic disease: a cross-sectional survey with telephone follow-up and data linkage.	N=102, aged 65 or older, admitted to hospitals, cross-sectional, July 2008 to Dec 2009, and 2010, Australia.	No spec. cut-off.	5 conditions. Admissions data and questionnaire. Patients with a total of 3 unplanned admissions in a 12 months period with one of the listed diagnoses as either principal or additional diagnosis were included.	COPD (J41-J44), diabetes (E10-E15), hypertension (I10 and I11.9), congestive heart failure (I50, I11.0 or J81) or coronary artery disease (I20-I25).	Hypertension.	For any of the conditions admission in a 12 months period from July 2008 to Dec 2009.	Not mentioned.	Calculated Charlson for each admission where severity is included.	No symptoms included.	R
Lupari E	2011	'We're just not getting it right'--how should we provide care to the older person with multi-morbid chronic conditions?	**Excluded: Systematic review.**									
de Souza Santos MacHado E	2012	Multimorbidity and associated factors in Brazilian women aged 40 to 65 years: a population-based study	**Excluded: No definition of MM.**									
de Souza Santos MacHado	2013	Aging, obesity, and multimorbidity in women 50 years or older: A population-based study	N=622, May 10 to Oct 31, 2011. Sao Paulo, Brazil. Cross-sectional, population-based. 50 years and older, women.	2 or more chronic conditions.	Self-reports interviewed by questionnaires including 12 conditions.	Diabetes, hypertension, myocardial infarction, stroke, cancer, osteoarthritis, osteoporosis, glaucoma, cataracts, urinary incontinence, chronic bronchitis/ asthma and pulmonary emphysema.	Hypertension and osteoporosis.	Asked about the amount of time since diagnosis and if current on treatment.	Not mentioned.	Not mentioned.	Urinary incontinence.	R

MacKnight E	2001	Use of the chronic disease score to measure comorbidity in the Canadian Study of Health and Aging	**Excluded: No definition of MM.**									
Marengoni	2008	Total lymphocyte count and in-hospital mortality in older persons with multimorbidity	N=596, 65 years and older, admitted to an acute-care Geriatric Unit of an Internal Medicine Department in Brescia, Italy. 1999-2000. Cross-sectional.	Cut-off: (Geriatric Index of Comorbidity) GIC<3 and GIC=4.	At admission each patient was examined medically, physically and neuropsychological. Used ICD-9; 9 groups of conditions. The most prevalent conditions were grouped in to the Greenfield Index of Disease Severity (IDS) which grades each disease on a 0-4 scale. Further, the co-existence of multiple disorders was measured with the Geriatric Index of Comorbidity (GIC), taking both the number and the severity in to account. NB! In IDS and GIC also the acute condition leading to the admission was included. Functional status: ADL, cognitive status: MMSE.	Heart diseases: coronary heart disease, heart failure and cardiac arrhythmias, hypertension: controlled and uncontrolled high blood pressure, cerebrovascular disease: ITA and stroke, gastro-hepatic disease: gastritis, peptic ulcer, pancreatic and biliary disorders, intestinal obstruction, hepatitis and cirrhosis, lung diseases: COPD and recurrent pneumonia, renal diseases: acute and chronic renal insufficiency, malignancies: both anamnestic and current malignant tumors (blood and solid), musculoskeletal diseases: arthritis and osteoporosis, diabetes: both controlled and uncontrolled types.	Hypertension and osteoporosis.	Malignancies include both anamnestic and current malignant tumors, but does not say anything about how far back in time.	Diseases grouped in to organ domains, but not more.	Measure severity with the Index of Disease Severity. Also including controlled and uncontrolled hypertension and diabetes. Does not describe how.	No symptoms included.	R
Marengoni	2008	Prevalence of chronic diseases and multimorbidity among the elderly population in Sweden.	N=1099, Stockholm, Sweden, 1987-2000, not stated age, but the elderly population in Sweden.	2 or more chronic conditions.	Diagnoses based on clinical assessment, medical history, laboratory data and current drug use. A disease was chronic if: permanent, caused by non-reversible pathological	All diagnoses in ICD-9 not stated specifically in advance.	Not mentioned.	Not mentioned. But had to be chronic: permanent, caused by non-reversible pathological changes or required rehab or long period of care.	Not mentioned.	Not mentioned, but probably measured for depression and dementia.	Not mentioned.	

					changes or required rehab or long period of care. Used ICD-9 with some exceptions: deafness (unable to hear the interviewer's voice), visual impairment (blind or almost blind), depression (DSM-IV) and dementia (DSM-III-R). 30 detected do not state in advance what they are.							
Marengoni	2008	Rehabilitation and nursing home admission after hospitalization in acute geriatric patients	N=830, aged 65 years and older, Italy, Feb 1998-Dec 2000, cross-sectional, secondary care (acute geriatric ward).	No spec. cut-off.	Medical, functional and neuropsychological assessment. The most prevalent conditions were grouped into 11 groups. ICD-9. MM measured with the Geriatric Index of Comorbidity (GIC) which includes both number and severity. Severity is measured with the Greenfield Index of disease Severity (IDS) which grade each disease on 0 to 4 scale: 0: absence of the disease, 1: asymptomatic, controlled disease, 2: symptomatic disease, controlled by the treatment, 3: uncontrolled disease, 4: life-threatening disease or of greatest severity. GIC is a 4-point scale:	Heart disease (coronary heart disease, heart failure and cardiac arrhythmias), hypertension (controlled and uncontrolled), cerebrovascular disease (TIA and stroke), diabetes, gastro-hepatic diseases (gastritis, peptic ulcer, pancreatico-biliar disorders, intestinal obstruction, hepatitis and cirrhosis), lung diseases (COPD and recurrent pneumonia), malignancies (current and anamnestic), renal diseases (both acute and chronic renal insufficiency), anemia, musculo-skeletal diseases (arthritis and fractures), and peripheral vascular diseases (arterial, venous thrombosis and pulmonary	Hypertension.	Malignancies (current and anamnestic), otherwise not mentioning duration.	Grouped in 11 related categories.	MM measured with the Geriatric Index of Comorbidity (GIC) which includes both number and severity. Severity is measured with the Greenfield Index of disease Severity (IDS) which grade each disease on a 0 to 4 scale.	No symptoms included.	R

					Class 1: only diseases with IDS=1, Class 2: at least 1 disease IDS=2, Class 3: 1 disease with IDS=3 and 1 or more with IDS=2, Class 4: 2 or more with IDS=3 or 1 or more with IDS=4. Also the acute condition leading to admission was included. Also measured ADL and MMSE.	embolism).						
Marengoni	2009	The impact of chronic multimorbidity and disability on functional decline and survival in elderly persons. A community-based, longitudinal study	N=1099, Sweden, community-based, longitudinal prospective cohort study, 1991-1993 baseline and 1994-1996 follow-up, aged 77-100 years old.	2 or more conditions.	Included 22 conditions with a known impact on disability and mortality. Diagnosed by a doctor (clinical examination, medical history, laboratory data and current drug use), diagnoses based on ICD-9 (used DSM-IV for depression, DSM-III-P for dementia, WHO criteria for anemia and obesity BMI >30). Chronic if: being permanent, caused by nonreversible pathological alteration or requiring a long period of care or rehabilitation.	Valvular heart disease, epilepsy, peripheral neuritis, Parkinson disease, rheumatic polymyalgia, arthritis, RA, obesity, anxiety, hip fractures, malignancy, COPD, diabetes, cerebrovascular diseases, major depression, atrial fibrillation, anemia, visual impairment, coronary heart disease, heart failure, dementia, and hypertension.	Hypertension and obesity.	Not mentioned.	Not mentioned.	Not mentioned.	Visual impairment.	D R
Marengoni	2009	Patterns of chronic multimorbidity in the elderly population	N=1099, Sweden, aged 77 and older, enrolled 1987 and follow-up in 1991-1993, community based cohort study.	2 or more conditions.	30 conditions were found in the population. They included the 15 most common conditions with a prevalence >3%. Diagnosed by a doctor (clinical	Visual impairment, heart failure, deafness, diabetes mellitus, hip fracture, atrial fibrillation, cerebrovascular disease, depression, coronary heart	Hypertension.	Not mentioned.	Not mentioned.	Not mentioned.	Visual impairment.	R

					examination, medical history, laboratory data and current drug use or register), diagnoses based on ICD-9 (deafness=unable to hear the interviewers voice, blindness=being blind or almost blind, major depression used DSM and dementia to different physicians made the diagnosis, anemia WHO definition. Chronic if: being permanent, caused by nonreversible pathological alteration or requiring a long period of care or rehabilitation.	disease, hypertension, malignancy, anemia, thyroid dysfunction, COPD and dementia.						
Marengoni E	2011	Aging with multimorbidity: A systematic review of the literature.	**Excluded: Systematic review.**									D
Marengoni	2013	Comparison of disease clusters in two elderly populations hospitalized in 2008 and 2010	N=1155 + 1173 (first and second wave), aged 65 years and older, Italy, secondary care (internal medicine and geriatric ward), 2008 and 2010, cross-sectional.	No spec cut-off.	Diseases collected at hospital discharge with: clinical examination, medical history, laboratory and instrumental data. Diagnoses using ICD-9. 19 conditions with a prevalence > 5% were included.	Anemia, anxiety, arthritis, atrial fibrillation, cerebrovascular diseases, coronary heart diseases, COPD, chronic renal failure, dementia, diabetes mellitus, dyslipidemia, gastric diseases, heart failure, hypertension, intestinal diseases, liver cirrhosis, malignancy, prostate hypertrophy and thyroid diseases.	Hypertension and dyslipidemia.	Not mentioned.	Not mentioned.	Not mentioned.	No symptoms included.	X R
Martin-Ruiz	2011	Assessment of a large panel of candidate	N=1042, 85 years and older.	No specific cut-off. Chronic	Questionnaires, measurements, functional tests,	Hypertension, ischemic heart disease,	Hypertension and osteoporosis.	Cancer diagnosed within past five years.	Not mentioned.	Not mentioned.	No symptoms included.	R

		biomarkers of ageing in the Newcastle 85+ study	Cross-sectional. Newcastle, UK. Registered with a participating National Health Service (NHS) general practice, not stated when.	conditions.	blood samples and medical records. 18 chronic conditions, does not state in the article what kind. After Collerton et al. 2009. 1 point if present and 0 if absent. Also MMSE and ADL.	cerebrovascular disease, peripheral vascular disease, heart failure, atrial flutter or fibrillation, arthritis (osteoarthritis or cervical or lumbar spondylosis or rheumatoid arthritis or other arthritis or non-specified arthritis), osteoporosis, COPD or asthma, other respiratory disease, diabetes, hypothyroidism or hyperthyroidism, cancer diagnosed within past five years (excluding non-melanoma skin cancer), eye disease (cataract or age related macular degeneration or glaucoma or diabetic eye disease or registered blind or partially sighted), dementia, Parkinson's disease and renal impairment.						
Martinson	2001	Physical inactivity and short-term all-cause mortality in adults with chronic disease.	N=1901, aged 40 years and older, US, 1994 (followed until 1999), population based HealthPartners (a Minnesota health plan in owned or contracted clinics), observational study.	2 or more chronic conditions.	4 conditions. Administrative data. Used ICD-9-CM and pharmacotherapy databases to find them. Survey to answer level of physical activity.	Diabetes (250.xx), heart disease (412, 413.9, 429.2 or 428.0), hypertension (401, 401.1, or 401.9) and dyslipidemia 272.4).	Hypertension and dyslipidemia.	For diabetes the member should have diagnose registered twice to be counted as having diabetes. For the rest of the conditions they only had to be counted once.	Not mentioned.	Not mentioned.	No symptoms included.	R
Mazya	2013	The ambulatory geriatric assessment – a	Protocol. Sweden, aged 75 years and	3 or more chronic conditions.	Diagnoses according to ICD-10.	Not mentioned specifically.	Not mentioned.	Not mentioned.	Not mentioned.	Not mentioned.	Not mentioned specifically.	

		frailty intervention trial (Age-FIT) – a randomized controlled trial aimed to prevent hospital readmissions and functional deterioration in high risk older adults: a study protocol.	older, secondary care, RCT.		Patients identified with administrative data.							
McCarron	2013	Patterns of MM in an older population of persons with an intellectual disability: Results from the intellectual disability supplement to the Irish longitudinal study on aging (IDS-TILDA).	N=753, aged over 40, Cross-sectional. Data from Ireland's National Intellectual Disability database (NIDD) with information on all people with intellectual disability as part of a longitudinal study of aging, 2008.	2 or more conditions.	Self-rated, questionnaire and interview by caregiver. 12 conditions. "Have you ever been diagnosed?"	Drawn from Charlson: Endocrine disease, eye disease, heart disease, joint disease, stroke, hypertension, cancer, lung disease, GI disease, and liver disease. Further were added: neurological disease (CP, epilepsy, MS, Parkinson's, spina bifida, muscular dystrophy, Alzheimer's disease, dementia, organic brain syndrome or senility or serious memory impairment) mental health problems (emotional, nervous or psychiatric condition, hallucinations, anxiety condition, depression, emotional problems, schizophrenia, psychosis, mood swings and manic depression).	Hypertension.	Not mentioned.	Not mentioned.	Not mentioned.	Emotional problems, mood swings, senility or serious memory impairment.	X? R
McDaid	2013	The effect of multiple chronic conditions on self-rated health, disability and	N=6159, Population-representative studies of health in	2 or more chronic conditions.	Say 7 conditions, but state 8. Self-reported "ever diagnosed by a doctor" and	Heart attack, angina, stroke, asthma, COPD, diabetes, musculoskeletal	No risk factors included.	Should be present the previous year, otherwise not mention duration.	Divided into 4 organ system groups: 1. Cardiovascular: heart attack,	The conditions were not graded according to severity.	Musculoskeletal pain (back pain).	R

		quality of life among the older populations of Northern Ireland and the Republic of Ireland: a comparison of two nationally representative cross-sectional surveys.	Ireland and North Ireland. Used all data for those aged 50 years and over. Cross-sectional. 2005 and 2007.		present the previous year. Disability, self-rated health and QoL – self-reports.	pain (RA, arthritis, and back pain) and cancer.			angina or stroke; 2. Respiratory: COPD and asthma; 3. Diabetes; 4. Musculoskeletal pain.			
McGee	1996	Patterns of comorbidity and mortality risk in blacks and whites	N=13247, 25-74 years, US, general population, cross-sectional, 1971-1975.	No spec cut off.	4 conditions. Medical examination.	Coronary heart disease, stroke, diabetes and hypertension.	Hypertension.	Not mentioned.	Not mentioned.	Not mentioned.	No symptoms included.	R
McRae	2013	Multimorbidity is associated with higher out-of-pocket spending: a study of older Australians with multiple chronic conditions.	N=4574, Australia, Seniors Australia a nation-wide organization, over 50 years old, cross-sectional, 2009.	No spec cut-off.	6 conditions. The most common and serious. Self-reports.	Cancer, heart disease, diabetes, arthritis, depression and anxiety.	No risk factor included.	Lasted more than 6 months.	Not mentioned.	Not included.	No symptoms included.	X D?
Menotti	2001	Prevalence of morbidity and multimorbidity in elderly male populations and their impact on 10-year all-cause mortality: The FINE study (Finland, Italy, Netherlands, Elderly).	N=2285 men. 65-84 years, Cohort study. Part of the seven country study, a cohort followed for 25 years to measure diff in CHD. Baseline (1985) and examinations every 5 years.	No spec cut off.	Questionnaires, self-reports and physicians diagnoses based on examinations and history of surgical procedures. 9 conditions.	Angina pectoris, myocardial infarction, stroke TIA, heart failure, intermittent claudicatio, COPD, diabetes and cancer.	No risk factors included.	For COPD productive cough for at least three months.	CHD: Angina pectoris, myocardial infarction, cerebrovascular accidents: stroke and TIA, Cardiovascular disease: Coronary heart disease, heart failure, cerebrovascular accidents and intermittent claudicatio, Chronic disease: any disease mentioned above.	Not mentioned.	No symptoms included.	
Min	2007	Multimorbidity is associated with better quality of care among vulnerable elders.	N=372, community-dwelling, 65 years or older. Cross-sectional. US, not stated when.	0, 1, 2, 3, 4 and 5 or 6. No specific cut-off.	Medical records. 8 conditions. Patients were randomly selected from the managed-care organizations and screened using Vulnerable Elders	Hypertension, coronary artery disease, COPD, osteoarthritis, diabetes, depression, osteoporosis and atrial fibrillation and	Hypertension and osteoporosis.	Not mentioned.	Not mentioned.	Not mentioned.	No symptoms included.	X R

					Survey and those with increased 2 year mortality risk were included.	congestive heart failure in combination.						
Moth E	2012	Chronic care management in Danish general practice – a cross-sectional study of workload and multimorbidity	**Excluded: No definition of MM.**									D
Nagel	2008	The impact of education on risk factors and the occurrence of multimorbidity in the EPIC-Heidelberg cohort.	N=13781, aged 50-75 years. June 1994 to Oct 1998, participants from the EPIC-Heidelberg cohort consisting of general population answering questions of nutrition and cancer. Cohort study. Heidelberg, Germany.	2 or more chronic conditions. Also multiple metabolic disease: defined as de co-occurrence of 0, 1, 2, 3 or more metabolic diseases: diabetes, hypertension, dyslipidemia, hyperuricemia.	Baseline: questionnaire food frequency and height and weight, smoking, physical activity and medical history. Follow-up: prevalent conditions were investigated by interviews; incident diseases were identified by active follow-up. Self-reports with questionnaire on physician diagnosed conditions and the year of diagnosis. Only cancer was double-checked in the medical record. The chronic conditions were grouped into 15 groups.	Cancer (except non-melanoma skin cancer), diabetes, thyroid disease, stroke, myocardial infarction, heart disease (except MI), lung disease (asthma and COPD), GI (reflux esophagitis, chronic gastritis, gastric ulcer, Crohn's disease, ulcerative colitis, chronic diverticulitis), liver/kidney disease, pancreatitis, muscle/bone diseases (RA, osteoporosis); diseases of CNS (MS, Alzheimer disease, Parkinson's disease), hypertension, dyslipidemia and hyperuricemia.	Hypertension, hyperlipidemia, osteoporosis and hyperuricemia.	In self-reports the patients state year of diagnose but do not mention spec. duration.	Grouped conditions in groups and created an extra MM-score: multiple metabolic diseases: defined as de co-occurrence of 0, 1, 2, 3 or more metabolic diseases: DM, hypertension, dyslipidemia, hyperuricemia.	Not mentioned.	No symptoms included.	R
Nagl	2012	Relationship between multimorbidity and direct healthcare costs in an advanced elderly population. Results of the PRISCUS trial	N=1937, Germany, aged 65 years and older, general practice population, cross-sectional.	No spec cut-off. Looking at 0 to +10 conditions.	33 patient-reported diseases were the base in the multimorbidity index. Not stated what diseases.	Not mentioned.	Not mentioned.	Not mentioned.	Not mentioned.	Not mentioned.	Not mentioned.	
Neelema n	2001	The distribution of psychiatric and somatic III health:	N=7076, 1996 as part of NEMESIS (a	Not a specific cut-off.	30 somatic and 13 psychiatric disorders.	Psychiatric disorders: Alcohol dependence	Hypertension.	Experienced the previous 1 year to be included.	Not mentioned.	Not mentioned.	Hearing problems, dizziness, chronic fatigue, alcohol	R

		associations with personality and socioeconomic status	project measuring prevalence and psychiatric use in the general population). The Netherlands. 18-64 years of age, studied over 1 year. Cross-sectional.		Interviewed at home by trained interviewers: Information on experience the previous year of somatic disorders, only included if medicated. Also selected information on neuroticism, self-esteem, psychological symptoms, recall of parental care, etc.	or abuse, drug dependence or abuse, major depression, bipolar illness, social phobia, simple phobia, agoraphobia, GAD, panic disorder, schizophrenia, dysthymia, OCD, eating disorder. Somatic conditions: MS, accidents, dermatosis, cancer, polyps, asthma, hearing problems, migraine, hypertension, Parkinson's disease, kidney stones, diabetes, gastric ulcer, hernia, thyroid disease, osteoarthritis, epilepsy, nephrosis, cystitis, heart disease, uterine prolapse, bowel problems, visual disorder, cholecystitis, cirrhosis, arthritis, stroke, dizziness, chronic fatigue and rheumatoid illness.					dependence or abuse and drug dependence or abuse.	
Neeleman	2002	Propensity to psychiatric and somatic ill-health: evidence from a birth cohort	N=3321, Birth cohort from 1946 followed 19 occasions until they were 43 years old (until 1989), cohort study, UK.	No specific cut-off. Chronic conditions.	At the age of 36 years they answered self-reported (Present State Examination) of 20 chronic conditions. Another home visit also asked about 18 signs of and symptoms of anxiety and depression and also about the medical conditions again.	Stroke, diabetes, cataract, epilepsy, hayfever, bronchitis, skin trouble, stomach trouble, gum sores, varicose veins, arthritis, backache, hernia, headache, dizziness, kidney trouble, asthma, hypertension, heart disease and gallbladder trouble.	Hypertension.	For the psychiatric symptoms they should have been present during the preceding year.	Not mentioned.	Psychiatric symptoms rated 1-5 depending on experience and frequency.	Skin trouble, stomach trouble, gum sores, back ache, headache and dizziness.	R
Nobili	2011	Association between clusters	N=1155, 65 years and	2 or more chronic	Collected at hospital admission:	Anemia, anxiety, arthritis, atrial	Dyslipidemia and	Not mentioned.	They explore clusters, but do	Use the Charlson Index	No symptoms included.	X R

		of diseases and polypharmacy in hospitalized elderly patients: results from the REPOSI study	older. Cross-sectional, 2008 Jan-Dec, secondary sector (geriatric and medicine wards), Italy.	conditions (identified clusters).	confirmed by clinical examination, clinical history and laboratory and instrumental data collected by physician. 19 diseases. Charlson was used to examine coexistence and severity of conditions.	fibrillation, cerebrovascular disease (CVD), CHD, COPD, chronic renal failure, dementia, diabetes, dyslipidemia, gastric diseases, heart failure, hypertension, intestinal diseases, liver cirrhosis, malignancy, prostate hypertrophy and thyroid diseases.	hypertension.		not decide in advance.	to measure severity.		
Nobrega	2009	Quality of life and multimorbidity of elderly outpatients	N=104, July – Dec 2006, Two outpatient clinics, both with primary care facilities, Sao Paolo, Brazil, no stated age limit, cross-sectional.	No specific cut-off. Chronic conditions.	For chronic conditions a review of medical records and response to CIRS-G (modified Geriatric Version). CIRS-G covers 13 organ systems. To measure QoL they used the WHOQOL-BRIEF questionnaire, self-administered, and also a self-evaluation of health with a single question.	Cardiac, vascular, respiratory, upper GI, lower GI, hepatic, renal, genitourinary, musculoskeletal/skin, neurological, psychiatric, endocrine/metabolic systems and eyes/ears/nose/throat.	Hypertension, osteoporosis and obesity.	1). Cancer diagnosed in the remote past without evidence of recurrence or sequelae in the past 10 years. 2). Cancer diagnosed in the past without evidence of recurrence or sequelae in the past five years. 3). Required chemotherapy, radiation, hormonal therapy or surgical procedure for cancer in the past five years. 4). Recurrent malignancy of life threatening potential/failed containment of the primary malignancy/palliative treatment stage.	Not mentioned.	Each organ system can be rated 0-4.	Smoking status, impaired vision, hearing impairment, vertigo, lightheadedness, dizziness, constipation, bleeding, vaginal bleeding, prostate problems and headaches.	RI
Noel	2007	The challenges of multimorbidity from the patient perspective	N=422, Cross –sectional survey. Primary care. Texas, US. 1997-2001.	Different cut-off for each cluster (e.g. 3 or 4).	Medical records. 45 diagnoses, 3 clusters, only states 16 diseases in the text. Also measures functional status, patients' perception of delivery of primary care, willingness to	Hypertension, hyperlipidemia, diabetes, ischemic heart disease, osteoarthritis, COPD, enlarged prostate, GERD, depression, low back pain, cancers (excluding skin cancer), cataract,	Hypertension, hyperlipidemia and obesity.	Not mentioned.	3 MM clusters. Can have other diseases than those mentioned in the clusters, but not diseases from one of the other clusters.	Not mentioned.	Low back pain, alcohol abuse and substance abuse.	R

					learn self-management skills and willingness to receive care from other health care providers.	obesity, tobacco abuse, congestive heart failure, anemia, PTSD, peripheral vascular disease, other anxiety disorders, glaucoma, peptic ulcer disease, irregular heart rate, alcohol, thyroid, other arthritis, stroke, impotence, gout, schizophrenia, asthma, renal disease, bipolar, skin cancer, substance abuse, Alzheimer's disease/other dementias, hepatitis C, rheumatology, chronic liver disease, hip fractures, transient ischemic attacks, seizures, gallbladder disease, bowel disease, HIV, and Hepatitis B.						
O'Neill E	2013	2012 -- That was the year that was	**Excluded: review.**									D?
Ornstein	2013	The prevalence of chronic diseases and multimorbidity in primary care practice: A PPRNet report	N=667,379, Cross-sectional, Texas US, Oct 2011, primary care.	2 and 3 or more chronic conditions.	24 chronic diseases. Clinical database with a common electronic health record. ICD-9	Hypertension, hyperlipidemia, depression, gastro esophageal reflux, diabetes, obesity, osteoarthritis, asthma, osteoporosis or osteopenia, migraine, coronary disease, atherosclerosis, COPD, chronic kidney disease, cerebrovascular disease, atrial fibrillation, heart failure, alcohol use disorders, dementia, peptic ulcer, chronic liver disease,	Hypertension, hyperlipidemia, osteoporosis and obesity.	Not mentioned.	Not mentioned in the methods.	Not mentioned.	Alcohol use disorders.	R

						epilepsy, RA, Parkinson's disease or syndrome.						
Paulus E	2013	Development of a national position paper for chronic care: Example of Belgium	**Excluded: Theoretical article (and a review).**									D?
Payne	2013	The effect of physical multimorbidity, mental health conditions and socioeconomic deprivation on unplanned admissions to hospital: a retrospective cohort study	N=180815, aged 20 years and older, Scotland, general practice, retrospective cohort study, 2006.	0, 1, 2, 3, >4	40 conditions of which 8 are mental (Barnett et al.) Register data from the Scottish Practice Team Information dataset. Mental conditions used as a binary variable >1 or 0.	Depression, hypertension, Painful condition, Asthma (currently treated), Coronary heart disease, Treated dyspepsia, Diabetes, Thyroid disorders, Rheumatoid arthritis, other inflammatory polyarthropathies & systematic connective tissue disorders, Chronic obstructive pulmonary disease, Anxiety & other neurotic, stress related & somatoform disorders, Irritable bowel syndrome, New diagnosis of cancer in last five years, Alcohol problems, Other psychoactive substance misuse, Treated constipation, Stroke & transient ischemic attack, Chronic kidney disease, Diverticular disease of intestine, Atrial fibrillation, Peripheral vascular disease, Heart failure, Prostate disorders, Glaucoma, Epilepsy (currently treated), Dementia,	Hypertension.	For any diagnose based on prescription: > 12 months. Cancer in last 5 years.	Not mentioned.	Not mentioned.	Painful condition, treated dyspepsia, treated constipation, low vision, learning disability, alcohol problems and other psychoactive substance misuse.	X? I R

						Schizophrenia (and related non-organic psychosis) or bipolar disorder, Psoriasis or eczema, Inflammatory bowel disease, Migraine, Blindness & low vision, Chronic sinusitis, Learning disability, Anorexia or bulimia, Bronchiectasis, Parkinson's disease, Multiple sclerosis, Viral Hepatitis and Chronic liver disease.						
Perrucio	2007	The relative impact of 13 chronic conditions across three different outcomes	N=130,880, Nationally representative, aged 12 years or older, Canada, 2000-2001, cross-sectional.	No spec. cut-off. Chronic conditions.	Self-reported chronic conditions. Long-term conditions that have lasted for or are expected to last more than six months, diagnosed by a health professional. 13 conditions. Questionnaire for self-rated health.	Allergies (food and non-food), back problems, arthritis/RA, high blood pressure, migraines, asthma, heart disease, suffering from effects of stroke, thyroid disease, diabetes, GI conditions (Crohn's disease, colitis, and stomach or intestinal ulcers), cancer, fibromyalgia and/or chronic fatigue syndrome.	High blood pressure.	Not mentioned.	Not mentioned.	Not mentioned.	Back problems.	D? R
Perrucio E	2012	Health burden in chronic disease: multimorbidity is associated with self-rated health more than medical comorbidity alone.	**Excluded: Co-morbidity.** Using osteoarthritis as index condition.									
Platt E	1984	The influence of age and multimorbidity on the pharmacokinetics and metabolism of spironolactone	**Excluded: No definition of MM.**									
Poitras E	2012	Validation of the	**Excluded: No**									

		disease burden morbidity assessment by self-report in a French-speaking population	**definition of MM.**									
Prados-Torres	2012	Multimorbidity patterns in primary care: interactions among chronic diseases using factor analysis.	N=275,682, Spain, aged 14 years or older, general practice. Dec 31 2008. Observational study.	2 or more Chronic conditions.	Diagnoses grouped according to 264 Expanded Diagnostic Clusters (EDC) of the ACG (had to convert ICPC to ICD-9). **The selection of chronic diseases was based on the one used by Salisbury et al 8114) but only those with a prevalence 1 % or more were included resulting in 84 conditions.** Medical records.	84 conditions.	Hypertension, obesity, osteoporosis and lipid disorder.	Def. of chronic: Lasts more than 6 months, past conditions that require ongoing disease management or have continuing implications, important conditions with a risk of recurrence.	Not mentioned unless in EDC.	Not more than what is in ACG.	Low back pain, cervical pain syndromes, and substance use.	D RI
Quiñones	2011	How does the trajectory of multimorbidity vary across black, white and Mexican Americans in middle and old age?	N=17517, Michigan, US. 51 years and older, nationally representative. Interviewed 1995-2006, Cohort study.	No spec cut-off 0 to 7.	Recruited from register data. 7 diseases. Self-reported. Could in subsequent interviews dispute their earlier given diseases. Geriatrician checked the validity of the reported diagnoses. Also self-rated health, ADL, IADL, BMI, depressive symptoms.	Hypertension, heart disease, diabetes, cancer, lung disease, arthritis, stroke.	Hypertension.	Not mentioned.	Not mentioned.	Not measured.	No symptoms included.	R
Reed	2011	Protocol for a randomized controlled trial of chronic disease self-management support for older Australians with multiple chronic diseases	N=252, aged 60 years and older, Australia, community dwelling, RCT. **NB protocol.**	2 or more conditions.	8 groups and 20 conditions. Medical records.	CVD (ischemic heart disease, cerebrovascular disease/stroke, peripheral vascular disease, congestive heart failure, hypertension), respiratory (asthma, COPD), musculoskeletal	Hypertension and osteoporosis.	Not mentioned.	Not mentioned.	Not mentioned.	Chronic back pain and insomnia.	X R

						(osteoarthritis, RA, other arthritis, osteoporosis, chronic back pain), psychological (depression, anxiety, insomnia), digestive (gastro-oesophageal reflux), kidney disease, diabetes (type 1 and 2) and cancer.						
Rijken	2005	Comorbidity of chronic diseases: effects of disease pairs on physical and mental functioning	N=1673, The Netherlands, non-institutionalized chronic disease patients recruited from primary care, over the age of 15 years, April 1998, cross-sectional.	No spec cut-off.	The criteria for inclusion were a somatic disease defined as chronic by The Netherlands Classification and Terminology Committee for Health or a condition not necessarily chronic but known for the GP for more than one year. Questionnaire and telephone interview. They finally included **6 conditions** that occurred in at least 100 of the included participants in a larger study.	Cardiovascular disease (ischemic heart disease, heart failure, cerebrovascular disease, atherosclerosis and other arterial obstructive/peripheral vascular disease, other cardiovascular disease) cancer (all except skin), arthritis (osteoarthritis of spine, RA/allied conditions, osteoarthritis other types), chronic respiratory disease (chronic bronchitis/bronchiectasis, emphysema/COPD, asthma) diabetes mellitus (type 1 and 2) and thyroid dysfunction (Goiter, hyperthyroidism/thyrotoxicosis, hypothyroidism/myxedema, other thyroid disease).	No risk factor included.	Not stated explicitly but use the definition of chronic from the Netherlands Classification and Terminology Committee for Health.	Not in the methods.	Not mentioned.	No symptom included.	D
Rincon-Gomez	2011	Perceived quality of healthcare in a multicenter, community-based population of polypathological patients	N=461, primary care, Seville, Spain, no age limit but average 74 years, cross-sectional, no date.	2 or more categories.	Diseases included in two or more of 8 clinical categories A-H. The disease was found in the medical record. Personal interview and if not able to	Cat A: Heart failure and ischemic heart disease, Cat B: autoimmune diseases or chronic renal disease, Cat C: COLD, Cat D: Chronic infl bowel	No risk factors included.	Chronic renal disease creatinemia or proteinuria for at least 3 months.	Divided into groups. But not mentioning clustering.	Not mentioned here but for Bernabeau-Wittel they mentioned severity.	No symptoms included.	

					respond the principal caregiver was interviewed. PP-criteria defined by Ollero-Baturone et al., 2007 (Spaninsh) (Bernabeau-Wittel also refers to this article).	disease or chronic liver disease, Cat E: stroke or neurol disease leading to motor deficit or cognitive impairment, Cat F: peripheral artery disease or diabetes with compl. Cat G: chronic anemia or cancer without curative possibilities, Cat H: chronic osteoarticular disease.						
Ritchie E	2013	Research priorities in geriatric palliative care: multimorbidity.	**Excluded: review.**									D
Rizza	2012	Age- and gender-related prevalence of multimorbidity in primary care: the Swiss fire project.	N=66212 (335117 encounters), Zurich, Switzerland, primary care, aged 20 years and older, Jan 2009-July 2011. Cross-sectional.	1. 2 or more conditions from diff rubrics of ICPC-2, 2. 2 or more conditions from diff chapters of ICPC-2, 3. 2 or more medical specialties.	147 of a total of 686 ICPC-2 codes were used because they were identified as chronic conditions. Registered encounters and what diagnoses they were coded with.	147 conditions see Appendix.	Hypertension (complicated and uncomplicated), osteoporosis, obesity, overweight and lipid disorder.	Used a concept of O'Halloran including both chronic diagnoses, symptoms and complains.	Not mentioned.	No severity.	Chronic alcohol abuse.	D X (lidt) R
Rockwood E	2012	Making mobility-related disability better: A complex response to a complex problem	**Excluded: Commentary.**									D?
Roughead E	2011	Multimorbidity, care complexity and prescribing for the elderly	**Excluded: review.**									D?
Salanitro E	2012	Inflammatory biomarkers as predictors of hospitalization and death in community-dwelling older adults	**Excluded: No def. of MM.**									

Salisbury	2011	Epidemiology and impact of MM in primary care: a retrospective cohort study	N=99,997, 18 years and older, data from the General Practice Research Database (GPRD), retrospective Cohort study, England. 1 April 2005- 31 March 2008.	1. 1 or more in QoF. 2. 1 or more in ACG.	Medical records. Two ways of defining MM: 1. Quality of outcomes framework, 17 diff important chronic conditions. 2. Adjusted Clinical Groups (ACG) Case-Mix System, with a wide list of chronic conditions, one or more conditions. Have 260 clinically homogeneous 'expanded diagnostic clusters' (EDC) 114 of the 260 were identified as chronic.	QoF: Asthma, atrial fibrillation, cancer, coronary heart disease, chronic kidney disease, COPD, dementia, depression, diabetes, epilepsy, heart failure, hypertension, learning disability, mental health problem (psychosis, schizophrenia, bipolar affective disorder), obesity, stroke, thyroid disease. ACG: 114 conditions.	Hypertension, obesity, osteoporosis and lipid disorder.	Def. of chronic: Lasts more than 6 months, past conditions that require ongoing disease management or have continuing implications, important conditions with a risk of recurrence.	Not mentioned unless in EDC.	Not more than what is in ACG.	Low back pain, cervical pain syndromes, seizure disorder, quadriplegia and paraplegia and substance use.	D RI
Salive	2013	Multimorbidity in older adults.	N=30,923,846, 2008, database of administrative claims data, US. Cross-sectional. Not stated age limit but says in the results section that 16.5% were younger than 65 years.	2 or more chronic conditions.	15 conditions. Claims data.	Cancer (colon, breast, lung and prostate), hypertension, hyperlipidemia, atrial fibrillation, ischemic heart disease, asthma, stroke, diabetes, arthritis ,heart failure, depression, chronic kidney disease, osteoporosis, Alzheimer's disease, COPD.	Hypertension, osteoporosis and hyperlipidemia.	Used information from the Chronic Condition Data Warehouse website where they have defined 27 chronic conditions. There are some definitions regarding duration, most illnesses require 1 year, some 2 or 3 years.	Not mentioned.	Not mentioned.	No symptoms included.	D X? R
Santos-Eggiman n E	2002	Evolution of the needs of older persons	**Excluded: Theoretical article.**									D?
Schäfer	2009	The German MultiCare-study: Patterns of multimorbidity in primary health care - protocol of a prospective cohort study	Protocol for Schäfer 2012. N=3050, aged 65 to 85, observational cohort study, Germany, general practice.	3 chronic conditions.	29 groups and 37 diagnoses. Chart review, GP-interviews and patient interviews. Will include 120 to 150 GP surgeries and 50 eligible patients will be contacted for each surgery. Started in 2008.	Diabetes mellitus (E10-14), arthrosis (M15-M19), chronic ischemic heart disease; angina pectoris (I20, I25), chronic thyroid disorders; goiter, visual disturbances, cardiac arrhythmia, malignant tumors, lower limb varicose,	Osteoporosis.	Chart review: The last quarter all diagnoses will be collected. GP interview: will give information on duration and severity (how many years and Likert-type scale 0 to 4). Patient interview: The same list but not psychiatric disorders	Not mentioned more than the grouping of some diseases e.g. RA and other soft tissue disorders.	GP interview: will give information on duration and severity (how many years and Likert-type scale 0 to 4).	Visual disturbances, urinary incontinence, dizziness or giddiness and alcohol abuse.	D R

					There are diagnostic ICD-10 codes for all diagnoses.	chronic lower respiratory diseases, atherosclerosis; intermittent claudicatio, depression, osteoporosis, chronic stroke; transient cerebral ischemic attack; impaired cerebral blood flow, heart failure, neuropathies, renal failure, intestinal diverticulosis, somatoform disorders, non-rheumatic mitral valve or aortic valve disorders, urinary incontinence, hearing loss, disorders of vestibular function; dizziness and giddiness, RA and other soft tissue disorders, anemia, migraine, psoriasis, anxiety disorder, Parkinson's disease, alcohol abuse; alcoholic liver disease.		or severity. Also pharmaceutical products used by the patient within the last three months.				
Schäfer	2010	Multimorbidity patterns in the elderly: a new approach of disease clustering identifies complex interrelations between chronic conditions.	N=63,104 men, 86,176 women, 65 years or older, 2006, claims data from health insurance company, Germany.	3 or more conditions	Claims data. 46 diagnosis groups. Diagnoses should be recorded three quarters of a year (2006) to be included.	Hypertension, lipid metabolism disorders, chronic low back pain, diabetes, joint arthrosis, chronic ischemic heart disease, thyroid dysfunction, severe vision reduction, cancer, cardiac arrhythmias, purine/pyrimidine metabolism disorders and gout, lower limb varicosis, prostatic hyperplasia, asthma	Hypertension, obesity, osteoporosis and lipid metabolism disorder.	Chronicity was assessed using a scientific expert report for formation of morbidity oriented risk adjustment scheme in the German Statutory Health insurance.	Grouped together if they had the same pathophysiological mechanisms.	Not mentioned.	Chronic low back pain, severe vision reduction, non-inflammatory gynecological problems, insomnia, incontinence, dizziness, chronic headache, sexual dysfunction and tobacco abuse.	X D R

						and COPD, atherosclerosis/peripheral arterial occlusive disease, depression, obesity, liver diseases, osteoporosis, chronic gastritis/gastroesophageal reflux disease, cerebral ischemia/chronic stroke, cardiac insufficiency, neuropathies, non-inflammatory gynecological problems, chronic cholecystitis/gallstones, allergies, insomnia, renal insufficiency, intestinal diverticulosis, hemorrhoids, somatoform disorders, cardiac valve disorders, urinary incontinence, severe hearing loss, dementia, dizziness, RA/chronic polyarthritis, urinary tract calculi, anemia, migraine/chronic headache, psoriasis, anxiety, sexual dysfunction, Parkinson's disease, tobacco abuse and hypotension.						
Schäfer	2012	The influence of age, gender and socio-economic status on multimorbidity patterns in primary care. First results from the MultiCare cohort study.	N=3189, Germany, cohort study, general practice, July 2008-Oct 2009.	3 or more chronic conditions.	From the cohort they randomly picked 50 patients (each from GPs) and used a list of 29 disorders. Recruited from 158 GP practices across Germany. Then the final sample was	Hypertension, lipid metabolism disorders, chronic low back pain, diabetes, joint arthrosis, chronic ischemic heart disease, thyroid dysfunction, severe vision reduction,	Hypertension, obesity, lipid metabolism disorder and osteoporosis.	Chronicity was assessed using a scientific expert report for formation of morbidity oriented risk adjustment scheme in the German Statutory Health insurance.	Grouped together if they had the same pathophysiological mechanisms.	Not mentioned.	Chronic low back pain, severe vision reduction, non-inflammatory gynecological problems, insomnia, incontinence, dizziness, migraine/chronic	X D R

					checked with chart review for ICD10 diagnoses and GP interviews using a list of **46 chronic conditions** (7 of the 46 diagnoses were not included at the baseline interviews, handled with open questions (chronic gastritis, insomnia, allergies, obesity, hypotension, sexual dysfunction and tobacco abuse)). Socio-demographic data from patient interviews.	cancer, cardiac arrhythmias, purine/pyrimidine metabolism disorders and gout, lower limb varicosis, prostatic hyperplasia, asthma and COPD, atherosclerosis/peripheral arterial occlusive disease, depression, obesity, liver diseases, osteoporosis, chronic gastritis/gastroesophageal reflux disease, cerebral ischemia/chronic stroke, cardiac insufficiency, neuropathies, non-inflammatory gynecological problems, chronic cholecystitis/gallstones, allergies, insomnia, renal insufficiency, intestinal diverticulosis, hemorrhoids, somatoform disorders, cardiac valve disorders, urinary incontinence, severe hearing loss, dementia, dizziness, RA/chronic polyarthritis, urinary tract calculi, anemia, migraine/chronic headache, psoriasis, anxiety, sexual dysfunction, Parkinson's disease, tobacco abuse and hypotension.					headache, sexual dysfunction and tobacco abuse.	
Schäfer	2012	Does Multimorbidity	N=121,389. 65 years or	No spec. cut off.	Claims data. 46 diagnosis	See above, the same disorders as for	Hypertension, obesity, lipid	Chronicity was assessed using a	Grouped together if they had the	Not mentioned.	Chronic low back pain, severe vision	X D

		influence the occurrence rates of chronic conditions? A claims data based comparison of expected and observed prevalence rates.	older, 2006, claims data from health insurance company, Germany. N=500,000 hypothetical patients based on a stochastic model. Cross-sectional.		groups. Diagnoses should be recorded three quarters of a year (2006) to be included. Included those who had one and not more than 12 chronic conditions.	Schäfer above.	metabolism disorder and osteoporosis.	scientific expert report for formation of morbidity oriented risk adjustment scheme in the German Statutory Health insurance.	same pathophysiological mechanisms.		reduction, non-inflammatory gynecological problems, insomnia, incontinence, dizziness, migraine/chronic headache, sexual dysfunction and tobacco abuse.	R
Schneider E	2006	Health care in seniority: crucial questions and challenges from the perspective of health services research	**Excluded: Theoretical article.**									D?
Schneider	2012	Prevalence of multimorbidity in medical inpatients	N=170, Switzerland, January 2009, tertiary care setting, retrospective cohort study, 18 years and older.	3 definitions of MM: 1. 2 or more of any ICD-10 diagnoses, 2. 2 or more of ICD-10 diagnoses from different chapters (I-XIV and XVII), 3. 2 or more diagnoses defined by Charlson/Deyo comorbidity index.	Administrative data, chart reviews (imaging and laboratory tests) and medical records. Not stated number or type of conditions for the first to definitions. For number 3 it is 19.	Myocardial infarct, Congestive heart failure, Peripheral vascular disease, Cerebrovascular disease, Dementia, Chronic pulmonary disease, Connective tissue disease, Ulcer disease, Mild liver disease, Diabetes, Hemiplegia, Moderate or severe renal disease, Diabetes with end-organ damage, Any tumor, Leukemia, Lymphoma, Moderate or severe liver disease, Metastatic solid tumor and AIDS.	No risk factor included.	Not mentioned.	Only in relation to chapters in ICD-10 and Charlson.	Included in Charlson with increasing severity down the list, but do not rate severity of individual conditions.	Hemiplegia.	D
Schram	2008	Setting and registry characteristics affect the prevalence and	Used 3 population registries (**LASA** N=2463 age 55-94, 2002,	2 or more chronic conditions.	**LASA**: 12 conditions, self-reports from patient and GP. **Rotterdam**: 14 and	**LASA:** asthma/COPD, cardiac disease, peripheral artery disease, diabetes,	Hypertension and obesity (BMI>30).	Chronic condition: lasting 12 months or longer and fulfilling one or both of following: 1.	Not mentioned.	Not mentioned.	Paraplegia.	D? S R

		nature of multimorbidity in the elderly	**Rotterdam** N=3550 age 65-99, 2002-2004, **Leiden 85+** N=599, age 85, 1997-1999). 2 GP registries (**CMR Nijmegen**, N=2895, age 55 years and older, 2005, and **RNUGP,** N=5610, 55 and older, 2006). 1 hospital register (**LMR,** N=1.058.234, age 55 and older, Jan 2003-Dec 2004). 1 nursing home registry (**RAI**, N=1274, age 55 and older, Jan-Dec 2005). The Netherlands		2 surgeries. Interview and physical examination. **Leiden 85+:** 12 Face to face interviews, medical history from GP or nursing home physician, medication from pharmacies. **CMR Nijmegen:** Database. Found 68 conditions overlapping with the 185 those over prevalence 2% were used. **RNUGP:** Database. Found 83 conditions overlapping with the 185 those over prevalence 2% were used. **Hospital setting:** All 185. Register. **RAI:** 28. Assessment tool completed by a trained nurse. Registries. Constructed a Chronic Condition Indicator and judged 578 ICD-9-CM codes – resulted in 185 chronic conditions.	stroke, RA/osteoarthritis, malignancies, hypertension, depression and anxiety (DSM IV). **Rotterdam:** Malignancies (GP inform only), diabetes, obesity (BMI>30), depression, anxiety, Parkinson's disease, eye diseases, hypertension, myocardial infarction, angina pectoris, atherosclerosis, underwent percutaneous transluminal coronary angioplasty and/or coronary artery bypass grafting, TIA, stroke, and dementia. **Leiden 85+:** Myocardial infarction, stroke, diabetes, Parkinson's disease, dementia, osteoarthritis, COPD, malignancies, TIA, angina pectoris, hypertension, and depression. **CMR Nijmegen, RNUGP and LMR** no spec conditions listed. **RAI:** Diabetes, thyroid disease, ischemic heart disease, arrhythmias, heart failure, unspecified heart disease, peripheral vascular disease, hypertension,		Limitations on self-care, independence or social interactions. 2. Need for medical products, services or special equipment.				

						stroke, TIA, RA/osteoarthritis, dementia, eye disease, cerebral palsy, malignancies, depression, anxiety, COPD/emphysema, asthma, Parkinson's disease, epilepsy, schizophrenia, paraplegia, multiple sclerosis, renal insufficiency and anemia.						
Schuz	2011	Medication beliefs predict medication adherence in older adults with multiple illnesses	N=309, Germany, population based, longitudinal study, aged 65-85 years old (the German Ageing Survey), 2009.	2 or more conditions.	Self-reported marked on a list of 23 conditions mentioned either in **the Charlson Comorbidity Index or the Functional Comorbidity Index**. Do not state exactly what 23 conditions. Time 1: interview and questionnaire, time 2: questionnaire only and time 3: interview and questionnaire.	FCI: Arthritis (rheumatoid and osteoarthritis), osteoporosis, asthma, COPD/acquired respiratory distress syndrome (ARDS) and emphysema, angina, congestive heart failure (or heart disease), heart attack (myocardial infarction), neurological disease (multiple sclerosis and Parkinson's), Stroke/TIA, peripheral vascular disease, diabetes type I and II, upper GI disease (ulcer, hernia, reflux), depression, anxiety/panic disorder, visual impairment (cataracts, glaucoma or macular degeneration), hearing impairment (very hard of hearing, even with hearing aids) degenerative disc disease (back disease, spinal stenosis, or severe	FCI: Obesity and/or BMI >30 and osteoporosis. Charlson: No risk factors included.	Not mentioned.	Not mentioned.	Included in Charlson.	FCI: Visual impairment, hearing impairments, and severe chronic back pain. Charlson: Hemiplegia.	RI

						chronic back pain), obesity and/or BMI >30. Charlson: Myocardial infarction, congestive heart failure, peripheral vascular disease, cerebrovascular disease, dementia, chronic pulmonary disease, connective tissue disease, ulcer disease, mild liver disease, diabetes, hemiplegia, moderate or severe renal disease, diabetes with end organ damage, malignancy, moderate or severe liver disease, metastatic solid tumor and AIDS.						
Schuz	2012	Self-efficacy and multiple illness representations in older adults: A multilevel approach.	N=305, Germany (the German Ageing Study), 65 years or older, population based survey, cross-sectional, not stated when.	2 or more conditions.	Self-reported marked on a list of 24 conditions mentioned either in **the Charlson Comorbidity Index or the Functional Comorbidity Index**. Also included common geriatric health problems: hypertension, hyperlipidemia and visual impairments. Not stated more specifically. Interview and questionnaire. 10 of the most prevalent conditions are stated in the results.	FCI: Arthritis (rheumatoid and osteoarthritis), osteoporosis, asthma, COPD/acquired respiratory distress syndrome (ARDS) and emphysema, angina, congestive heart failure (or heart disease), heart attack (myocardial infarction), neurological disease (multiple sclerosis and Parkinson's), Stroke/TIA, peripheral vascular disease, diabetes type I and II, upper GI disease (ulcer, hernia, reflux), depression, anxiety/panic disorder, visual impairment	Hypertension and hyperlipidemia. FCI: Obesity and/or BMI >30 and osteoporosis. Charlson: No risk factors included.	Not mentioned.	Not mentioned.	For each illness the patient should mark the degree of subjective illness from 1=no burden to 4= very heavy burden.	Visual impairment and hearing impairment. FCI: Visual impairment, hearing impairments, and severe chronic back pain. Charlson: Hemiplegia.	D? RI

						(cataracts, glaucoma or macular degeneration), hearing impairment (very hard of hearing, even with hearing aids) degenerative disc disease (back disease, spinal stenosis, or severe chronic back pain), obesity and /or BMI >30. Charlson: Myocardial infarction, congestive heart failure, peripheral vascular disease, cerebrovascular disease, dementia, chronic pulmonary disease, connective tissue disease, ulcer disease, mild liver disease, diabetes, hemiplegia, moderate or severe renal disease, diabetes with end organ damage, malignancy, moderate or severe liver disease, metastatic solid tumor and AIDS. Also added hypertension, hyperlipidemia and visual impairment.						
Shadami	2006	Morbidity and older persons' perceptions of the quality of their primary care	N=120 65 years and older. Cross-sectional study. Community-dwelling members of a capitated health plan, patients of four	2 or more conditions.	ACG case mix used to measure level of morbidity. Calculated an aggregate morbidity level, of 1 to 6 (low to high) based on ICD-9 codes on 12 months of insurance claims.	Hypertension, ischemic heart disease, osteoarthritis, diabetes mellitus, congestive heart failure, COPD, depression, dementia and Parkinson's disease.	Hypertension.	Not mentioned.	Not mentioned.	Not mentioned.	No symptoms included.	RI

			general practitioners, US.		They estimated prevalence of 9 chronic conditions.							
Sharkey	2003	Risk and presence of food insufficiency are associated with low nutrient intakes and multimorbidity among homebound older women who receive home-delivered meals	N=279 women, 60 years and older, homebound as a result of disability, Oct 2000-May 2001, North Carolina, US, cross-sectional.	No spec. cut-off.	In-home interviews and telephone-administered dietary recalls. Self-reports of 9 diagnoses and its effects on IADL. Also, 15-item Geriatric depression Scale, BMI, IADL.	Heart disease or angina, congestive heart failure, high blood pressure, diabetes, lung disease (asthma, emphysema or chronic bronchitis), arthritis, osteoporosis, stroke and kidney disease.	High blood pressure and osteoporosis.	Not mentioned.	Not mentioned.	Reported effects of IADL for each condition 0=no effect, 1=present and little or large effect. The scores were summed and then dichotomized into a burden score 0=<3 diseases and 1=>3 diseases.	No symptoms included.	R
Skolasky E	2011	Psychometric properties of the patient activation measure among multimorbid older adults	**Excluded: No definition of MM.**									
Smith	2008	Multimorbidity in younger deprived patients: an exploratory study of research and service implications in general practice.	N=92, Dublin, Ireland (two practices). General practice setting. Cross-sectional. 45-64 years. May 28-June 22 2007.	3 or more chronic conditions.	Eligible for the General Medical Service (poorest 28% of the population, with free primary care, based on capitation payment system). Uses WHO definition and O'Halloran's definition of chronic diseases for primary care.	Conditions form O'Halloran. 147 chronic conditions.	Hypertension (complicated and uncomplicated) , obesity, osteoporosis, overweight and lipid disorder.	Uses WHO definition and O'Halloran's definition of chronic diseases for primary care. Not stating anything else about duration.	Not mentioned.	Not mentioned.	Chronic alcohol abuse.	R
Smith E	2009	From consultation-liaison psychiatry to integrated care for multiple and complex needs	**Excluded: Review.**									
Smith E	2012	Interventions for improving outcomes in patients with multimorbidity in primary care and community settings (review).	**Excluded: Systematic review.**									D?

Smith E	2012	Managing patients with multimorbidity: systematic review of interventions in primary care and community settings.	**Excluded: Systematic review.**									D
Soubhi E	2006	Perceived conflict in the couple and chronic illness management: preliminary analyses from the Quebec Health Survey	**Excluded: No definition of MM.**									D
Soubhi E	2007	Toward an ecosystemic approach to chronic care design and practice in primary care	**Excluded: Theoretical article.**									D?
Soubhi E	2010	Learning and Caring in Communities of practice: Using relationships and collective learning to improve primary care for patients with multimorbidity.	**Excluded: Theoretical article.**									
Stalbrand	2007	Subjective health and illness, coping and life satisfaction in an 80-year-old Swedish population-implications for mortality	N=212, Sweden, aged 80-95 years old, longitudinal population study starting in 1993, selected patients born in 1908.	2 or more diseases.	Check list of 30 items (and 7 domains) of symptoms patients have experienced the last three months. Check list of 12 self-reported or doctors' examination of diagnoses, accordingly: depression, subjective health, life satisfaction and coping. Divided into 4 groups: Basically healthy: 0-	Diabetes, hypertension, angina pectoris, congestive heart failure, claudicatio intermittens, stroke, urinary incontinence, neurological disease, cancer/tumors, major trauma, hip fracture and non-hip fractures.	Hypertension and overweight.	Not mentioned.	Not mentioned.	Not mentioned.	**Depression:** exhaustion, sleeping disturbance, general fatigue, depression, cries easily; **tension:** irritability, nervousness, impaired concentration, difficulty relaxing, restlessness; **gastrointestinal/urinary tract symptoms:** difficulty in passing urine, anorexia, nausea, diarrhea,	D R

					1 disease and 0-6 symptoms, Disease-ridden: 2-7 diseases and 0-6 symptoms, Symptom-ridden: 0-1 disease and 7-22 symptoms and unhealthy group: 2-7 diseases and 7-22 symptoms.						constipation, abdominal pain; **musculoskeletal symptoms:** pain in the joints, backache, pain in the legs; **metabolic symptoms:** feeling cold, sweating, loss of weight, overweight; **heart/ lung symptoms:** coughing, chest pain, breathlessness; **and symptoms related to the head:** dizziness, headache, impaired hearing and eye problems.	
Starfield E	2007	Global health, equity, and primary care	**Excluded: Commentary.**									D?
Starfield E	2008	Primary care in Canada: coming or going?	**Excluded: Commentary.**									
Starfield E	2011	Multimorbidity and its measurement.	**Excluded: Theoretical article.**									D
Steinhaeuser E	2011	Questionnaire of chronic illness care in primary care-psychometric properties and test-retest reliability.	**Excluded: No definition of MM.**									
Steinman	2012	Patterns of multimorbidity in elderly veterans.	N=1.9 million men and 39000 women. 65 years and older. Enrolled 1.Oct 2006 (should be alive 1 year later). Collected information for	No specific cut-off.	List of 23 conditions. Administrative data, diagnoses of discharge and outpatient care.	Arthritis, coronary heart disease, cerebrovascular accident, peripheral arterial disease (incl aortic aneurisms), COPD, diabetes, heart failure, atrial fibrillation, depression,	Hypertension, osteoporosis and hyperlipidemia.	Not mentioned.	Not mentioned.	Not mentioned.	Dyspepsia.	X R

			2 years. California, US, observational study.			hypertension, cancer other than c. prostate, c. prostate, anemia, hypothyroidism, dementia, epilepsy, benign prostatic hypertrophy, Parkinson's disease, osteoporosis, hyperlipidemia, gout, chronic renal insufficiency, and GI (gastroesophageal reflux disease, peptic ulcer and dyspepsia).						
Stewart	2013	Comparisons of multi-morbidity in family practice-issues and biases	3 studies: Collected information on Stewart only. Already have the others from their original publications. N=2998, Canada, retrospective cohort study, 2006-08, no age limit.	2 or more chronic conditions.	Medical records. List of 98 conditions from ICPC-2 (where 85 are coded as chronic) and 13 added by the authors. Also refers to CIRS.	Cardiac, Vascular Hematological Respiratory Ophthalmological and ORL Upper gastrointestinal Lower gastrointestinal Hepatic and pancreatic Renal Genitourinary Musculoskeletal and tegumental Neurological Endocrine, metabolic, breast Psychiatric.	Not stated what risk factors and not clear when reading the references. Probably only using CIRS and hence no risk factors are included.	Included conditions currently under medical management.	Not mentioned.	Severity is included in CIRS.	No symptoms included.	D
Sturmberg E	2012	Caring for people with chronic disease: is 'muddling through' the best way to handle the multiple complexities?	**Excluded: Theoretical article.**									
Taylor	2010	Multimorbidity – not just an older person's issue. Results from an Australian biomedical study.	N=3206, Adelaide, Australia. Cross-sectional, population-based. Stage 1: Jan 2000-July 2003	2 or more chronic conditions.	7 conditions. Data from North West Adelaide Health Study – population based biomedical cohort study. Monitor chronic conditions	Asthma (tested), cardiovascular disease (heart attack, stroke or angina), COPD (tested), diabetes, a current mental health condition	Osteoporosis.	Not mentioned.	Not mentioned.	Not mentioned.	Stress related problem or other mental health problem.	R

			– telephone interview and clinical examination. Stage 2: May 2004-Feb 2006. Computer assisted telephone interview, self completed questionnaire and a biomedical examination.		and related risk factors. Also measured CES-D (depressive symptoms the last week), smoking, alcohol, physical activity, risk factors; BP, BMI, cholesterol, waist/hip-ratio, circumference. And SF-36, medicines and services.	(anxiety, depression, stress related problem, other mental health problem), arthritis and osteoporosis. For all except asthma and COPD the conditions were self reported.						
Thanapop	2009	Profile of hospital charges for chronic conditions by health status and severity level: a case study of 4 provinces in Thailand	N=19,526, 2002-2004, Thailand, secondary care, case study, no age limit.	No cut-off.	Included 4 conditions. Administrative data.	Diabetes (E 10-14), hypertension (I10-I15), chronic lower respiratory diseases (J40-47) and chronic renal failure (N18-19).	Hypertension.	Not mentioned.	Not mentioned.	Include severity.	No symptoms included.	R
Thorell	2012	Licit prescription drug use in a Swedish population according to age, gender and socioeconomic status after adjusting for level of multi-morbidity	N=400,000, Östergötland, Sweden, aged 20 years and over. 2006. Cross-sectional. Primary and secondary care.	RUB 4 and 5	Register data. ACG Case-Mix system divided into groups according to sum of diagnoses recorded during a defined period of time, based on that MM corresponds to a certain need for health care resources. Resource Utilization Band (RUB) can be divided in 1 to 5 1=no need of health care, 2=preventive care, 3=single chronic condition and 4 and 5=MM.	No specific conditions listed 25,000 are included in ACG.	Hypertension and more.	Definition of chronic in ACG is 1 year.	Clustered according to resource use.	RUB includes severity because conditions demanding more resources are more severe.	Backache, cannabis abuse, etc.	RI
Tinetti E	2011	Contribution of multiple chronic conditions to universal health outcomes	**Excluded: Co-morbidity.**									D
Tinetti	2012	Contribution of individual	N=22890, Longitudinal	Not spec cut-off.	Diagnoses from hospital,	No spec diseases stated.	Disorders of lipid	Data were available 9 months before	Not mentioned.	Not mentioned.	Symptoms explicitly	

		diseases to death in older adults with multiple diseases	study, National representative sample, 2002-2006, aged 65 years and older, US.		outpatient, physician and skilled nursing facility Medicare claims data. ICD-9-CM. Diseases were assigned to a single level Clinical Classification Software (CCS). Codes relating to: symptoms, physical, laboratory, imaging, pregnancy and birth were removed. Otherwise all codes were included; when similar codes were combined it resulted in 97 chronic conditions and 36 acute diseases.		metabolism, hypertension, osteoporosis and obesity.	enrolment. So if present here considered prevalent, if not, incident.			excluded.	
Tooth	2008	Weighted multimorbidity indexes predicted mortality, health service use, and health-related quality of life in older women	N=10434, cross sectional, aged 70-75 years, 1996-2005 (data from survey 1999). Australia. General population.	Not a spec cut off.	Self-reports: number of GP visits, visits to specialists, hospitalization (last 12 months), and SF-36. Self-reported chronic and acute conditions (yes/no). Only chest pain and urinary incontinence was reported ordinal with severity. Not specified what conditions. Cancer (except non-melanoma skin-cancer) was grouped together. In the result section 19 conditions are listed.	Heart disease, chest pain, stroke, hypertension, fall (caused serious injury), fall (required medical attention, fall (caused fractures), urinary incontinence, low iron, arthritis, osteoporosis, bronchitis/emphysema, asthma, diabetes, skin cancer, other cancers, depression, anxiety and Alzheimer's disease.	Hypertension and osteoporosis.	Not mentioned.	Not mentioned.	Only chest pain and urinary incontinence was reported ordinal with severity.	Chest pain, falls and urinary incontinence.	D? R
Tourkmani	2012	Medication adherence among patients in a	N=347, Saudi Arabia, June to Sept 2010,	One or more conditions.	Medical records data and self-reports.	Hypertension, diabetes, dyslipidemia,	Hypertension and dyslipidemia.	Not mentioned.	Not mentioned.	Not mentioned.	No symptoms included.	R

		chronic disease clinic	primary, preventive to tertiary care (hospital that provides health care for 1.3 million Saudi military personnel and their families). Cross-sectional (3 months duration). 18 years and older.		8 conditions.	asthma, thyroid disorders, RA, osteoarthritis, complex chronic disease.						
Tucker-Seeley	2011	Lifecourse socioeconomic circumstances and multimorbidity among older adults	N=7305 Michigan, US. Cross-sectional. From a national longitudinal study of older Americans funded by the National Institute on aging. 50 years and older, 2004.	No specific cut-off.	6 chronic conditions. Self-reports.	Cancer, heart disease, lung disease, stroke, diabetes and hypertension.	Hypertension.	Not mentioned.	Not mentioned.	Not mentioned.	No symptoms included.	D? R
Uijen	2008	Multimorbidity in primary care: prevalence and trend over the last 20 years.	N=13584 (patient years), general practice but representative for the general Dutch population, observational study. The Netherlands. 1985-2005.	0, 1, 2, 3, or >4 chronic conditions.	Register data. In Continous Morbidity Registration (CMR) there are two types of chronic conditions: obligatory: COPD or dementia – lifelong and conditionally: depression and asthma – medical attention may be stopped after some years. If they do not have their own International classification of health problems in primary care code they are excluded.	Not specifying diseases in advance. Include all diagnoses in CMR that has an ICHPPC-2 code.	Not stated.	Chronic conditions diagnosed for the first time in 2005 was not included. Chronic: based on def from Commission on chronic illness (US) – permanent, leave residual disability, caused by non-reversible pathological alteration, require special training, require long period of supervision, observation and care.	Not mentioned.	Not mentioned.	Not specified.	D
Valderas E	2009	Defining comorbidity: Implications for understanding health and health	**Excluded: Theoretical article and a review.**									D

		services.										
Van Baal E	2011	Co-occurrence of diabetes, myocardial infarction, stroke, and cancer: quantifying age patterns in the Dutch population using health survey data.	**Excluded: Co-morbidity.**									
van den Akker	1998	Multimorbidity in general practice: Prevalence, incidence, and determinants of co-occurring chronic and recurrent diseases	N=60857, The Netherlands, 1994, database from general Practice, age from 0 years. Prospective cohort study.	2 or more chronic conditions.	RNH database, ICPC-codes. For this study they only used active codes relating to diagnostic categories meaning attention of the GP or patient, present treatment, subsequent diagnostic investigations, disease monitoring or a known progressive course. Some codes were excluded: pregnancy, risk factors, superficial injuries, variation of normal function, etc. A total of 335 diagnostic categories were included. They excluded hemorrhoids.	Not stated but 335 chronic conditions in total.	Hypertension. NB! They excluded overweight (BMI<30). Other risk factors may be included in RNH.	Health problems only coded if: permanent (no recovery expected), chronic (duration longer than 6 months), recurrent (more than three recurrences within 6 months) or lasting consequences for function or prognosis.	Not stated.	Not stated.	Codes representing symptoms and complaints were not chosen.	D RI
van den Akker	2000	Marginal impact of psychosocial factors on multimorbidity: Results of an explorative nested case-control study	N=3745 case-control, The Netherlands, 20 years and older. 1 Sep 1992-31 Aug 1995. Health problems registered in Registration Network Family Practices (RNH).	2 or more chronic conditions.	Cases: subjects with new MM during the period of three years. Controls: No new disease in the period, also a group with one new condition. 335 diagnostic categories. The questionnaire was similar for cases and controls with:	Not stated but 335 chronic conditions in total.	Hypertension (uncomplicated), obesity BMI > 30. Other risk factors may be included in RNH.	Health problems only coded if: permanent (no recovery expected), chronic (duration longer than 6 months), recurrent (more than three recurrences within 6 months) or lasting consequences for function or prognosis.	Not mentioned.	Not mentioned.	Tobacco abuse, feeling anxious/nervous/tense/inadequate, low back symptoms, overweight BMI < 30. More symptoms may be included in RNH.	D RI

					sociodemographic variables, SES, occupation, general health (incl BMI), health-related behavior (smoking, alcohol, and sports), family medical history, long-term difficulties, and life events, health locus of control, coping style, social network and values.							
van den Akker E	2001	Problems in determining occurrence rates of multimorbidity	**Excluded: Theoretical article.**									D!
van den Akker	2001	Psychosocial patient characteristics and GP-registered chronic morbidity: A prospective study	N=3351, prospective cohort study (2 years follow up), The Netherlands, Jan 1996-Dec 1997, 20 years and older. Health problems registered in Registration Network Family Practices (RNH).	2 or more chronic conditions.	Baseline: questionnaire with demographic, life style and psychological/socio logical characteristics (stress management, locus of control, life events, long-term difficulties, living arrangements). Morbidity was measured using health problems registered in Registration Network Family Practices (RNH). Medical records, ICPC-codes. For this study they only used active codes relating to diagnostic categories meaning attention of the GP or patient, present treatment, subsequent diagnostic investigations,	Not stated but 335 chronic conditions in total.	Hypertension. NB! They excluded overweight (BMI<30). Other risk factors may be included in RNH.	Health problems only coded if: permanent (no recovery expected), chronic (duration longer than 6 months), recurrent (more than three recurrences within 6 months) or lasting consequences for function or prognosis.	Not stated.	Not stated.	Codes representing symptoms and complaints were not chosen.	D RI

					disease monitoring or a known progressive course. Some codes were excluded: pregnancy, risk factors, superficial injuries, variation of normal function, etc. A total of 335 diagnostic categories were included. They excluded hemorrhoids.								
van den Akker	2006	In an exploratory prospective study on multimorbidity general and disease-related susceptibility could be distinguished	N=3460, cohort study, The Netherlands, Jan 1996-Dec 1997, 20 years and older. Health problems registered in Registration Network Family Practices (RNH).	2 or more chronic conditions.	Baseline: questionnaire with demographic, life style and psychological/sociological characteristics (stress management, locus of control, life events, long-term difficulties, living arrangements). Morbidity was measured using health problems registered in Registration Network Family Practices (RNH). Medical records, ICPC-codes. Some codes were excluded; postoperative complications, and codes with too broad spectrum. Does not state total number of included disorders. After review of records those with more than one diagnose were divided in disorders of general susceptibility and disorders of	Not stated but 335 chronic conditions in total.	Hypertension (uncomplicated), obesity BMI > 30. Other risk factors may be included in RNH.	Health problems only coded if: permanent (no recovery expected), chronic (duration longer than 6 months), recurrent (more than three recurrences within 6 months) or lasting consequences for function or prognosis.	Not mentioned.	Not mentioned.	Tobacco abuse, feeling anxious/nervous/tense/inadequate, low back symptoms, overweight BMI < 30. More symptoms may be included in RNH.	D RI

					disease-related susceptibility (based on literature search).							
Van den Brink E	2013	Residents with mental-physical multimorbidity living in long-term care facilities: prevalence and characteristics. A systematic review.	**Excluded: Systematic review.**									
van den Bussche	2011	Patterns of ambulatory medical care utilization in elderly patients with special reference to chronic diseases and multimorbidity--results from a claims data based observational study in Germany	N=123,224, Germany, aged 65 years and over, Jan-Dec 2004, cross-sectional, claims data from ambulatory medical care sector, representative for the population as a whole.	3 or more chronic conditions.	Claims data. 46 conditions. Used a list of "Expert Report for the selection of 50 to 80 Diseases to be included in the Morbidity Based Risk Adjustment Scheme" and an expert panel grouped the ICD-10 codes to groups of similar conditions.	Hypertension, lipid metabolism disorder, chronic low back pain, severe vision reduction, joint arthrosis, diabetes, chronic ischemic heart disease, thyroid disease, cardiac arrhythmias, obesity, purine/pyrimidine metabolism disorders/gout, prostatic hyperplasia, lower limb varicosis, liver disease, depression, asthma/COPD, non-inflammatory gynecological problems, atherosclerosis/PAOD, osteoporosis, renal insufficiency, cerebral ischemia/chronic stroke, cardiac insufficiency, severe hearing loss, chronic cholecystitis/Gallstones, somatoform disorders, hemorrhoids, intestinal diverticulosis, RA/chronic polyarthritis, cardiac valve disorders,	Hypertension, lipid metabolism disorder, osteoporosis and obesity.	3 quarters of the year 2004 to be considered as chronic.	Not mentioned.	Not mentioned.	Chronic low back pain, severe vision reduction, dizziness, urinary incontinence, chronic headache, sexual dysfunction, non-inflammatory gynecological problems, insomnia and tobacco abuse.	XD R

						neuropathies, dizziness, dementia, urinary incontinence, urinary tract calculi, anemia, anxiety, psoriasis, migraine/chronic headache, Parkinson's disease, cancer, allergy, chronic gastritis/GERD, sexual dysfunction, insomnia, tobacco abuse and hypotension.						
van den Bussche	2011	Which chronic diseases and disease combinations are specific to multimorbidity in the elderly? Results of a claims data based cross-sectional study in Germany	N=123,224, Germany, aged 65 years and over, 2004, cross-sectional, claims data, representative for the population as a whole.	3 or more chronic conditions.	Claims data, 46 conditions. Used a list of "Expert Report for the selection of 50 to 80 Diseases to be included in the Morbidity Based Risk Adjustment Scheme" and an expert panel grouped the ICD-10 codes to groups of similar conditions.	See van den Bussche "Patterns of ambulatory medical care…"	Hypertension, lipid metabolism disorder, osteoporosis and obesity.	3 quarters of the year 2004 to be considered as chronic.	Not mentioned.	Not mentioned.	Chronic low back pain, severe vision reduction, dizziness, urinary incontinence, chronic headache, sexual dysfunction, gyn dis, insomnia and tobacco abuse.	XD R
van den Bussche E	2013	A comparative study demonstrated that prevalence figures on multimorbidity require cautious interpretation when drawn from a single database	**Excluded: Already included.** Comparing two studies already described: Schäfer and van den Bussche.									D?
Van Eijk	2012	Predicting prosthetic use in elderly patients after major lower limb amputation	N=38, The Netherlands, Jan 2008-March 2010, prospective design, no age limit, skilled nursing facilities.	Charlson Index score over 1.	Charlson Index score, but with exclusion of (PAD) peripheral arterial disease and diabetes because they are related to amputation. Both medical examination and medical charts.	Myocardial infarction, congestive heart failure, peripheral vascular disease, cerebrovascular disease, dementia, chronic pulmonary disease, connective tissue disease, ulcer disease, mild liver disease, diabetes,	Not included.	Not mentioned.	Not mentioned.	Included in The Charlson Index.	Hemiplegia.	

						hemiplegia, moderate or severe renal disease, diabetes with end organ damage, any tumor, leukemia, lymphoma, moderate or severe liver disease, metastatic solid tumor and AIDS.						
Van Oostrom	2012	Multimorbidity and comorbidity in the Dutch population - data from general practices	N=212,902, The Netherlands, general practice network database (representative for the population), 2002-2008, cross-sectional.	2 or more chronic conditions.	Electronic medical records. 29 chronic conditions.	Tuberculosis, HIV/AIDS, cancer, gastric or duodenal ulcer, chronic enteritis/colitis ulcerosa, visual disorder, hearing disorder, congenital cardiovascular anomaly, coronary heart disease, heart failure, stroke, chronic back or neck disorder, RA, osteoarthritis, osteoporosis, congenital neurological anomaly, MS, Parkinson's disease, epilepsy, chronic alcohol abuse, dementia, schizophrenia, anxiety disorder/neurosis/PTSS, depressive disorder, mental retardation, COPD, asthma, anorexia, and diabetes.	Osteoporosis.	Chronic defined as irreversible conditions without complete recovery or relatively long-lasting conditions. Do not mention a specific time limit. But patients should have been registered with the condition in three consecutive years in GP network to be included.	Not mentioned.	Not mentioned.	Chronic alcohol abuse.	X R
van Oostveen E	2013	Explaining the amount of care needed by hospitalised surgical patients: a prospective time and motion study	**Excluded: No definition of MM.**									
Van Royen E	2011	Series: The research agenda for general	**Excluded: Theoretical article.**									

		practice/family medicine and primary health care in Europe. Part 6: reaction on commentaries - how to continue with the Research Agenda?										
Vogel	2012	The impact of perceived social support and sense of coherence on health-related quality of life in multimorbid primary care patients	N=103, primary care, Germany, Dec 2009 – April 2010, aged 18 years and older, cross-sectional.	No cut-off in the methods, describes in the results 2 or more is considered MM.	4 conditions. Also had to give details of burden of a list of 20 conditions: Hypertension, angina pectoris, asthma, gastric ulcer, duodenal ulcer, type 1 diabetes, type 2 diabetes, COPD, chronic heart failure, depression, chronic renal failure, cataract, glaucoma, cancer, osteoarthritis of knee or the hip, chronic back pain, femoral neck fracture, depression, other psychiatric disorders and Parkinson's disease. Found by claims data and or referred by primary care physician.	Inclusion: type 2 diabetes, COPD, heart failure; depression (late life >60 years old).	No risk factor included.	Not mentioned.	Not mentioned.	Not mentioned. (Should report the burden of co-occurring conditions).	No symptoms included.	
Vogeli E	2007	Multiple chronic conditions: prevalence, health consequences, and implications for quality, care management, and costs	**Excluded: review.**									D
Vogt-Ferrier E	2011	Older patients, multiple comorbidities, polymedication... should we treat everything?	**Excluded: review (also theoretical article).**									D?

Vos	2013	Multimorbidity in older women: The negative impact of specific combinations of chronic conditions on self-rated health.	N=315, The Netherlands, aged 70-74 years, general practice population, but representative for the Dutch population. Cross-sectional. April 2000-Jan 2002.	2 conditions out of 5 prevalent chronic conditions.	The patients are selected from a database: Data from the Second Dutch National Survey of General practice (DNSGP-2). Asked to participate; health interview survey, computer assisted. Had to answer if they suffered from one or more chronic conditions 12 months prior to the interview. Fixed list developed by the auspices of statistics Netherlands. Self-reports. To study MM they selected the top five chronic conditions on the list and the most prevalent combinations of two conditions containing at least one of these five conditions. Self-rated health measured with the Short-Form 36.	The five most common conditions were: osteoarthritis (hip or knee), anxiety, hypertension, depression and urinary incontinence. Other conditions were also looked for (this is all disorders they state in the article's result section): severe condition of neck/shoulder, severe back pain, severe condition of elbow/wrist/hand, diabetes, asthma/COPD, migraine/severe headache, cancer, RA, dizziness with falling, cerebrovascular incident, severe bowel disorder >3 months, chronic eczema, other serious heart condition, myocardial infarction, stenosis in aorta or aa. femorales, psoriasis. They do not state more in the ref 12 article.	Hypertension.	Should be experienced during the prior 12 months, not mention for how long.	Not mentioned, regardless of that they choose pairs of conditions were at least one of the five conditions is included.	Do not mention severity of the conditions.	Urinary incontinence. Also looked for severe condition of neck and shoulder, severe back pain, severe condition of elbow/wrist/hand, severe headache and dizziness with falling.	X D SRH R
Walker	2007	Multiple chronic diseases and quality of life: patterns emerging from a large national sample, Australia	N=26,863 (NHSo1) and, 36,241+ 5145 (SDAC03). Aged 20 years and older, Australia, national survey, National Health Survey (NHS01) 2001, and Survey of	3 or more chronic conditions.	Self-reports on conditions due to injury, illness or disability. Told by a doctor or a nurse, lasted for >6 months and had at the time for interview.	Only states chronic illnesses with serious implications for health and/or functionality. States the following: Arthritis, and musculoskeletal conditions, asthma, cancer, cardiovascular health, diabetes,	Not mentioned.	Lasted or expected to last more than 6 months and had the disease at the time of the interview.	Not mentioned.	Not mentioned.	Not specified if symptoms are included.	

			Disability, Ageing and Carers 2003 (SDAC03), cross-sectional.			injury prevention and control and mental health.						
Warner	2010	Giving and taking--differential effects of providing, receiving and anticipating emotional support on quality of life in adults with multiple illnesses	N=1415, Germany, age 40-85 years, population-based community-dwelling, 2002, cross-sectional.	2 or more chronic conditions.	Personal interview and questionnaire. 11 conditions (self-reported). Functional health: SF-36, depressive symptoms: CES-D scale, QoL: WHOQOL-BREF (WHO).	Cardiovascular diseases, diabetes, respiratory disease. Do not state more specifically what the 11 conditions are. The conditions were informed by Charlson Comorbidity Index.	Not mentioned but risk factors are not included in Charlson.	Not mentioned.	Not mentioned.	Use the Charlson Index, but not what conditions.	Not mentioned but hemiplegia is included in Charlson.	
Warner	2012	Health-specific optimism mediates between objective and perceived physical functioning in older adults	N=309, Germany, 65-85 years, from a population representative survey. 2009. Longitudinal study.	2 or more chronic conditions was criterion for be included in the study.	Questionnaire and interviews. At least 2 chronic conditions according to Charlson Comorbidity Index or Functional Comorbidity Index. Also, physical functioning (chair rise test), health specific optimism questionnaire, perceived physical functioning SF-36 and general self-efficacy.	FCI: Arthritis (rheumatoid and osteoarthritis), osteoporosis, asthma, COPD/acquired respiratory distress syndrome (ARDS) and emphysema, angina, congestive heart failure (or heart disease), heart attack (myocardial infarction), neurological disease (multiple sclerosis and Parkinson's), Stroke/TIA, peripheral vascular disease, diabetes type I and II, upper GI disease (ulcer, hernia, reflux), depression, anxiety/panic disorder, visual impairment (cataracts, glaucoma or macular degeneration), hearing impairment (very hard of hearing, even with hearing aids) degenerative disc disease (back	FCI: Hypertension and hyperlipidemia. Obesity and/or BMI >30 and osteoporosis. Charlson: No risk factors included.	Not mentioned.	According to Charlson et FCI. Not mentioned specifically.	According to Charlson et FCI. Not mentioned specifically.	FCI: Visual impairment, hearing impairments, and severe chronic back pain. Charlson: Hemiplegia.	RI

						disease, spinal stenosis, or severe chronic back pain), obesity and /or BMI >30. Charlson: Myocardial infarction, congestive heart failure, peripheral vascular disease, cerebrovascular disease, dementia, chronic pulmonary disease, connective tissue disease, ulcer disease, mild liver disease, diabetes, hemiplegia, moderate or severe renal disease, diabetes with end organ damage, malignancy, moderate or severe liver disease, metastatic solid tumor and AIDS.						
Warner	2013	Interactive effects of social support and social conflict on medication adherence in multimorbid older adults	N=309, Germany, 65-85 years, from a population representative survey. 2009. Longitudinal study.	2 or more chronic conditions was criterion for be included in the study.	Questionnaire and interviews. At least 2 chronic conditions according to Charlson Comorbidity Index or Functional Comorbidity Index. Also: general received social support and social conflict and medication-specific social support.	See Warner 2012: "Health-specific optimism mediates between objective and perceived physical functioning in older adults".	FCI: Hypertension and hyperlipidemia. Obesity and/or BMI >30 and osteoporosis. Charlson: No risk factors included.	Not mentioned.	According to Charlson et FCI. Not mentioned specifically.	According to Charlson et FCI. Not mentioned specifically.	FCI: Visual impairment, hearing impairments, and severe chronic back pain. Charlson: Hemiplegia.	RI
Webb	2012	Suicide risk in primary care patients with major physical diseases: a case-control study	N=873 cases were matched with 17460 living controls by age and gender, nested case-control study, family practice England, Jan	3 or more chronic conditions.	Register data (Read/OXMIS codes) primary care database. 11 conditions. Also, clinical depression.	Cancer, coronary heart disease, hypertension, stroke, diabetes, asthma, COPD, osteoarthritis, osteoporosis, back pain and epilepsy.	Hypertension and osteoporosis.	Not mentioned.	Not mentioned.	Not mentioned.	Back pain.	X R

			2001 to Dec 2008. No age limit.									
Webb	2012	Risk of self-harm in physically ill patients in UK primary care	N=2306 cases were matched with 46,120 living controls by age and gender, nested case-control study, family practice England, Jan 2001 to Dec 2008. No age limit.	No spec. cut-off. But states that the method is almost identical with Webb 2012 estimating suicide.	Register data (Read/OXMIS codes) primary care database. 11 conditions. Also, clinical depression.	Cancer, coronary heart disease, hypertension, stroke, diabetes, asthma, COPD, osteoarthritis, osteoporosis, back pain and epilepsy.	Hypertension and osteoporosis.	Not mentioned.	Not mentioned.	Not mentioned.	Back pain.	X R
Welmer	2012	Can chronic multimorbidity explain the age-related differences in strength, speed and balance in older adults?	N=3323, Cross-sectional, aged 60 years and older, Sweden, Population-based, 2001-2003.	No spec. cut-off.	Clinical examination, medical history and laboratory data. Counted the number of diagnoses according to ICD-10 (and DSM-IV for dementia), but did not state a number of certain diagnoses in advance. The condition was classified as chronic if: prolonged in duration, and one or more of the following: leaving residual disability or worsening of quality of life or requiring a long period of care or treatment. The diseases were divided in to four categories: 0=reference, 1-2 chronic diseases, 3-4 diseases and 5+ diseases.	Not mentioned.	Not mentioned.	The condition was classified as chronic if: prolonged in duration.	Not mentioned.	Not mentioned.	Not mentioned.	
Wensing E	2011	Tailored Implementation For Chronic Diseases (TICD): a	**Excluded: No definition of MM.**									

		project protocol										
Wolff	2002	Prevalence, expenditures, and complications of multiple chronic conditions in the elderly	N=1,217,103, 65 years and older, US, cross-sectional study, nationally representative (Medicare program), 1999.	No spec. cut-off.	ADG clusters based on ICD-9-CM from ACG. 32 diagnostic morbidity clusters, they selected 12 representing 3493 ICD-9-CM codes (five-digit) of chronic conditions. **ICD-9-CM codes were grouped into 24 organ systems =major diagnostic category (MDC). MDC 23 was excluded because it includes "other factors". Every MDC was the unit for comorbidity analysis because each MDC is treated by a single speciality.** To be classified as having a chronic condition: at least 1 inpatient, skilled nursing facility or home health care medical claim or 2 or more outpatient hospital contacts or 1 or more ICD-9-CM code for chronic condition.	MDC: Myeloproliferative, kidney, hepatobiliary, blood and immunological, nervous system, digestive, mental, ear/nose/throat, respiratory, female reproductive, skin/subcutaneous tissue/breast, eye, musculoskeletal, male reproductive, endocrine/nutritional/metabolic and circulatory. Excluded MDC: Pregnancy (MDC14), newborn (MDC15), infectious and parasitic diseases (MDC18), alcohol/drug (MDC20), injury MDC21), burns (MDC22), other factors (MDC23) and human immunodeficiency virus (MDC25).	Hypertension is included in circulatory system.	Not mentioned.	ICD-9-CM codes were divided into 24 organ system =major diagnostic category (MDC) serving as the entity of chronic condition. Otherwise not mentioning clusters.	Involvement of several categories often indicates higher severity.	Not mentioned.	D R
Wong	2011	Longitudinal administrative data can be used to examine multimorbidity, provided false discoveries are controlled for	N=4,521,856, The Netherlands, secondary care (hospital admissions). 1995-2004. No age limits. Longitudinal.	2 or more diseases.	Register data. Used ICD-9, but with a higher aggregation level - the International Shortlist for Hospital Morbidity Tabulation (ISHMT). 138 groups of diseases. 8 of external cause and therefore excluded, also excluded:	138 groups covering most chapters in ICD-10.	Osteoporosis, hypertension, obesity and lipid metabolism disorders.	Used different time intervals, but not mention for how long a condition should have been known.	Not mentioned in the methods, but in the results.	Not mentioned.	Explicitly excluding symptoms.	D

					pregnancy, conditions in perinatal period, congenital, malformations, symptoms, injury and contacts with health services. Both chronic and non-chronic.							
Wrede E	2013	Complex health care decisions with older patients in general practice: patient-centeredness and prioritization in consultations following a geriatric assessment	**Excluded: No definition of MM.**									

Table 2. Results of checking reference lists. 21 articles were found and read in full text 13 were included.

Author	Year	Title	Population, art, age and number	Definition of MM	Number of disorders included and sources of data	Type of disorders if special disorders	Complications and risk factors included, if so what kind	Duration	Clusters and connections between disorders	Severity mentioned, if so how	Symptoms	Comments
Agborsangaya	2013	Health-related quality of life and healthcare utilization in multimorbidity: results of a cross-sectional survey	N=4946, general population, aged 18 years and older, Alberta, Canada, 2010, cross-sectional.	2 or more chronic conditions (stated in the results section).	Telephone-based questionnaire. 14 conditions and an open question leading to two additional conditions. 16 in total.	Diabetes, COPD, asthma, hypertension, high cholesterol, sleep apnea, congestive heart failure, obesity, depression or anxiety, chronic pain, arthritis, heart disease, stroke or cancer, and two additional: diseases of the gastrointestinal tract and kidney diseases.	Hypertension, high cholesterol and obesity.	Health status the past 12 months.	Not mentioned.	Not mentioned.	Chronic pain.	R
Bayliss	2004	Predicting declines in physical function in persons with multiple chronic medical conditions: What we can learn from the medical problem list	N=1574, both from primary care and specialty practices, US, observational study, 1986-1990, no age limit.	No spec cut off, 0, 1, 2, 3, and 4+.	6 conditions. Medical interview by a trained clinician. Compare with a group of patients with hypertension alone.	Diabetes (type 1 and 2), cardiac disease (myocardial infarction within the past 6 months), history of angina, current angina, myocardial infarction more than 1 year ago), congestive heart failure, respiratory	No risk factors included.	Myocardial infarction within the past 6 months, myocardial infarction more than 1 year ago, history of angina.	Divided in main disease categories.	Not mentioned.	Back pain and musculoskeletal complaints.	

						disease (asthma, COPD, other lung disease), musculoskeletal disease (back pain, musculoskeletal complaints, hip impairment, osteoarthritis, rheumatoid arthritis), depression (diagnosed depression, symptoms of depression).						
Bayliss	2005	Subjective assessments of comorbidity correlate with quality of life health outcomes: initial validation of a comorbidity assessment instrument	N=157, primary, specialty and hospital care, US, survey, aged 65 years and older, not stated when.	No spec cut off.	25 chronic conditions. Self-reports and medical records. Also compared with RxRisk and Charlson.	Angina/coronary artery disease, asthma, back pain, bronchitis/COPD, cancer, cholesterol (elevated), colon problem (diverticulitis, irritable bowel), congestive heart failure, diabetes, hard of hearing, hypertension, kidney disease, nerve condition, osteoarthritis, osteoporosis, overweight, poor circulation (peripheral vascular disease), rheumatic disease other, rheumatic arthritis,	Cholesterol (elevated), hypertension, overweight,	Cancer the past five years. All conditions preceding the survey with two years. Required 2 outpatient or 1 inpatient diagnosis. Conditions that were cured or fixed by for example surgery were not included.	Not mentioned.	Had to rate if it interfered with daily activities, 1=not at all to 5=a lot.	Back pain, hard of hearing and vision problem.	X D R

						stomach problem (gastritis, peptic disease), stroke, thyroid disorder and vision problem.						
Boyd E	2005	Clinical practice guidelines and quality of care for older patients with multiple comorbid diseases implications for pay for performance	**Excluded: No definition of MM.**									
Boyd	2010	Clarifying multimorbidity to improve targeting and delivery of clinical services for Medicaid populations	N=5,187,176, the most disabled of the general population insured by Medicaid, US, aged 21 years and older, 2001-2002, cross-sectional?.	No spec. cut-off.	Started with a list of 50 conditions reduced first to 31 and then finally to 13 based on high prevalence, high costs and/or potential opportunities for improved management.	Asthma/COPD, cerebrovascular accident/stroke, chronic pain, chronic renal failure/ESRD (end stage renal disease), congestive heart failure, coronary heart disease, dementia, depressive disorders, developmental disorders, diabetes, drug and alcohol disorders, hypertension and schizophrenia.	Hypertension.	Not mentioned.	Not mentioned.	Not mentioned.	Chronic pain. Drug and alcohol disorders.	X R
Boyd E	2010	Clarifying multimorbidity patterns to improve targeting and delivery of clinical services for Medicaid populations	**Excluded: Same as in the report "Clarifying multimorbidity to improve targeting and delivery of clinical**									

			services for Medicaid populations", this one briefer.									
Boyd E (not the author, but one of the panel members)	2012	Guiding principles for the care of older adults with multimorbidity: an approach for clinicians	**Excluded: No definition of MM.**									D
Cornell	2007	Multimorbidity clusters: clustering binary data from multimorbidity clusters: clustering binary data from a large administrative medical database	N=1,327,328, Veterans Health Administration, primary care, 1997-2000, US, no age limit, cross-sectional?.	2 or more chronic conditions.	45 diagnoses (38 medical and 7 psychiatric). Database (National Patient Care Database).	Hypertension, hyperlipidemia, diabetes, ischemic heart disease, osteoarthritis, COPD, enlarged prostate, GERD, depression, low back pain, cancers (excluding skin cancer), cataract, obesity, tobacco abuse, congestive heart failure, anemia, PTSD, peripheral vascular disease, other anxiety disorders, glaucoma, peptic ulcer disease, irregular heart rate, alcohol, thyroid, other arthritis, stroke, impotence, gout,	Hypertension, hyperlipidemia and obesity.	The patients had to have at least one primary care contact in three of the four years not necessarily consecutive.	Not mentioned.	Not mentioned.	Low back pain, irregular heart rate, alcohol, impotence, tobacco abuse, seizures and substance abuse.	X R

						schizophrenia, asthma, renal disease, bipolar, skin cancer, substance abuse, Alzheimer's disease/other dementias, hepatitis C, rheumatology, chronic liver disease, hip fractures, transient ischemic attacks, seizures, gallbladder disease, bowel disease, HIV, and Hepatitis B.						
Fortin E	2004	Multimorbidity in the medical litterature: A bibliometric study	**Excluded: Not found.** Probably the same as "Multimorbidity is common to family practice: is it commonly researched?"									
Fried	2012	Multiple chronic conditions among adults aged 45 and over: trends over the past 10 years	N=30,682 (1999-2000) and N=29,523 (2009-2010), non-institutionalized general population of United States, US, report.	2 or more conditions.	9 conditions. Self-reports.	Hypertension, heart disease, diabetes, cancer, stroke, chronic bronchitis, emphysema, current asthma, and kidney disease.	Hypertension.	For almost all conditions the patients were asked: "Have you ever been told by a doctor..?" For asthma: During the past 12 months have you had an episode of	Not mentioned.	Not mentioned.	No symptoms included.	X R

								asthma? And for hypertension the patients had to be told at least twice that they have it.				
Marengoni E	2009	Multimorbidity: the syndrome of the aging population. Occurrence and patterns of multimorbidity	**Excluded: Oral communication.**									
Marengoni	2011	Prevalence of disability according to multimorbidity and disease clustering: a population-based study	N=1099, Stockholm, Sweden, 1987-1993, population-based, elderly population aged 75 years and older, prospective cohort study.	No spec cut off, 0, 1, 2, 3, and 4+.	30 conditions selected in the population. Diagnoses based on clinical examination, medical history, laboratory data and current drug use. Also inpatient registers system for some of the conditions. A disease was chronic if: permanent, caused by non-reversible pathological changes or required rehab or long period of care. Used ICD-9 with some exceptions: deafness (unable to hear the interviewer's voice), visual impairment (blind or almost blind), depression and dementia (DSM-III-R). Anemia (hbg < 12 g/dl women and <13 g/dl for men).	Cardiovascular system (heart diseases and hypertension), cerebrovascular system diseases (stroke and TIA), mental diseases (dementia, depression, and schizophrenia), neurosensory diseases (parkinsonism, epilepsy, deafness, and visual impairments), endocrinological system diseases (diabetes and thyroid problems), musculoskeletal system diseases (hip fracture, arthritis, polymyalgia, and osteoporosis),	Hypertension and osteoporosis.	Not mentioned.	Divided in organ systems.	Not mentioned.	Visual impairments.	R

						respiratory system diseases (COPD), malignancy (blood and solid) and blood diseases (anemia).						
Schellevis	1992	Comorbidity of chronic diseases in general practice	N=1989, 1988, The Netherlands, general practice, cross-sectional, no age limit.	No spec cut off.	Either from consultation, repeat prescriptions or another administrative reason for visiting the practice (during the first 3 months). Also medical records	Hypertension, diabetes, chronic ischemic heart disease (angina pectoris, previous myocardial infarction, coronary sclerosis), chronic nonspecific lung disease (asthma, chronic bronchitis, emphysema) and osteoarthritis of hip and/or knee.	Hypertension.	Not mentioned.	Not mentioned.	Not mentioned.	No symptoms included.	R
Schneider	2009	Prevalence of multiple chronic conditions in the United States Medicare population	N=1,649,574, Medicare population, US, 2005, cohort.	2 or more chronic conditions.	Claims data. 6 conditions.	Cancer (female breast, colorectal, prostate and lung cancer), chronic kidney disease, COPD, depression, diabetes and heart failure.	No risk factors included.	For cancer, COPD and depression 1 year look back period, for chronic kidney disease, diabetes and heart failure 2-year look back period.	Not mentioned.	Not mentioned.	No symptoms included.	X

Schoenberg	2007	Burden of common multiple-morbidity constellations on out-of-pocket medical expenditures among older adults	N=8,180, nationally representative, aged 65 years and older (in 1998), 1998 and 2002, cross-sectional, US.	No spec. cut-off.	8 chronic conditions. Self-reports.	High blood pressure, diabetes, cancer, lung disease, heart conditions, stroke, arthritis, and psychiatric problems (including emotional and nervous conditions).	High blood pressure.	Not mentioned.	Investigated different combinations of diseases but not talking about clustering.	Not mentioned.	Psychiatric problems (including emotional and nervous conditions).	X R
Starfield E	1990	Ambulatory Care Groups: A Categorization of Diagnoses for Research and Management	**Excluded: No definition of MM.**									
Stewert E	2009	Implementing and maintaining a researchable database from electronic medical records: a perspective from an academic family medicine department	**Excluded: No definition of MM.**									
Summa E	1995	Multimorbidity in old age	**Excluded: German.**									
Thiem E	2010	Prerequisites for a new health care model for elderly people with multimorbidity	**Excluded: No definition of MM.**									
Van den Akker	1998	Morbidity in responders and non-responders in a register-based population survey	N=3744, The Netherlands, 20 years and older, cases: 2 or more new diagnoses the last three years, controls 0 or 1	2 or more new chronic conditions.	Self-reports and database. Used data from the Registration Network Family Practices. Comparing prevalence of 40 predefined randomly selected conditions. Do not state what	Not stated, but RNH has information about hypertension (uncomplicated) and obesity BMI > 30.	Not mentioned.	Not mentioned.	In the results diagnoses are grouped in body systems but do not mention clustering.	Not mentioned.	No stated, but RNH has information about tobacco abuse, feeling anxious/nervous/tense/inadequate, low back	R

			new diagnose, general practice, not stated when.		type.						symptoms and overweight BMI < 30.	
Van der Linden	2001	The relation between health locus of control and multimorbidity: a case-control study	N=3745, The Netherlands, nested case-control study, 20 years and older, cases: 2 or more new diagnoses the last three years, controls 0 or 1 new diagnose, general practice, not stated when.	2 or more new chronic conditions.	Self-reports and database. Used data from the Registration Network Family Practices. Do not state type and number of conditions.	Not stated.	Not mentioned.	Not mentioned.	In the results diagnoses are grouped in body systems but do not mention clustering.	Not mentioned.	No stated.	
Warner	2011	Maintaining autonomy despite multimorbidity: self-efficacy and the two faces of social support	N=309, aged 65-85 years old, population-based, 2008-2009, longitudinal study, Germany.	2 or more chronic conditions.	Interview and questionnaire. Conditions mentioned either in Charlson Comorbidity Index or the Functional Comorbidity Index. Not specified further.	Not specified more than included in Charlson and FCI.	Not specified more than included in Charlson and FCI.	Not mentioned.	Not more than in Charlson.	Not more than in Charlson.	Not specified more than included in Charlson and FCI.	

Explanation of letters in right margin

D=can be of interest for discussion

X=explain selection of conditions

R=risk factor included