Inštitut za ekonomska raziskovanja
Institute for Economic Research

12th World Congress in Health Economics (IHEA 2017)

Boston, Massachusetts, United States
8-11 Jul, 2017

MULTIPLE CHRONIC CONDITIONS IN OLDER PEOPLE AND THEIR EFFECTS ON HEALTH CARE UTILIZATION: A NETWORK ANALYSIS APPROACH USING SHARE DATA

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Structure of the presentation

1) Introduction and short literature review
2) RQ and Hypotheses
3) Data and Method
4) Results – Network analysis
5) Results – Econometric modelling
6) Discussion and Conclusion

Introduction and short literature review

The presence of multiple coexisting chronic diseases in individuals and the expected rise in chronic diseases over the coming years are increasingly being recognized as major public health and health care challenges of modern societies (Marengoni et al., 2011; WHO, 2009; Vogeli et al., 2007; Glynn et al., 2011; Smith and O'Dowd, 2007; Barnett et al., 2012).

Individuals with multiple conditions are presumed to have greater health needs, more risk of complications, and more difficulty to manage treatment regimens.

At present, the main health care model is disease-focused rather than person-focused and, therefore, involvement of several different health care providers in managing multiple disorders is inevitable and often results in competing treatments, sub-optimal coordination and communication between care providers, and/or unnecessary replication of diagnostic tests or treatments (Vogeli et al., 2007; Clarfield et al., 2001; Greß et al., 2009).

As a consequence, the common belief is that persons with multiple diseases have high rates of health care utilization and this is confirmed by some international studies (Glynn et al., 2011; Starfield, 2006; Fortin et al., 2007; Laux et al., 2008; Salisbury et al., 2011; van den Bussche et al., 2011; Lehnert et al., 2011).

Introduction and short literature review

People with polypathology may represent 50% or more of the population living with chronic diseases, at least in high-income countries. For instance, a systematic review of 25 Australian studies conducted from 1996 to 2007 found that half of the included elderly patients with arthritis also had hypertension, 20% had cardiovascular disease (CVD), 14% diabetes and 12% a mental health condition.

Similarly, over 60% of patients with asthma reported living with arthritis, 20% CVD and 16% diabetes; and of those with CVD, 60% also had arthritis, 20% diabetes and 10% had asthma or mental health problems (Caughey et al., 2008).

A study of a random sample of 1,217,103 patients from the United States who had been receiving Medicare services for over a year (and so were 65 or older) showed that two thirds (65%) had multiple chronic conditions (Wolff, Starfield & Anderson, 2002). Studies of patients admitted to hospitals in Spain also show a prevalence of polypathology ranging from 42% to just over 57% (Medrano Gónzalez et al. 2007; Zambrana García et al., 2005).

Introduction and short literature review

Key issues (Andalusian Ministry of Health conference, 2009):

Epidemiological issues;

The language of polypathology and assessment of complexity;

Prevention and health promotion;

Disease management models;

Patient education and self-management;

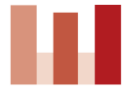
Primary care and integrated management processes;

Supportive and palliative care;

Demedicalization of care (with emphasis on complementary and alternative interventions);

Economic, social and political implications;

The Promise of Genomics, Robotics, Informatics/eHealth and Nanotechnologies (GRIN).

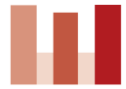


Introduction and short literature review

In our article we use SHARE dataset of Wave 5 (covering year 2013), including data for 15 countries: Austria, Germany, Netherlands, France, Switzerland, Belgium, Luxembourg, Sweden, Denmark, Spain, Italy, Czech Republic, Slovenia, Estonia, Israel

We model the presence of multiple coexisting chronic diseases as a network analysis problem (following e.g. Goyal and Joshi, 2003; Soramaki et al., 2007; Hiller, 2014).

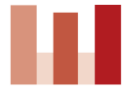
This has special scientific relevance as, to our knowledge, network analysis has not been used so far to study this problem, and, also, very seldom before in the analysis using SHARE data.



Research questions

Main research questions of the analysis:

1) **What are the most frequent combinations of chronic diseases among older people in Europe?**
2) **What are the effects of multiple coexisting chronic diseases on health care utilization of the older people?**
3) **Are there different effects on health care utilization for different groupings of diseases?**
4) **Does the method used improve the previously used / other possible models?**

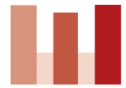


Method

The main method we use is social network analysis.

We consider two persons as connected if they share a common disease among the above mentioned ones. In this manner, we get a 2-mode network where diseases serve as the second mode and persons (with diseases) as the first.

In the analysis we group the diseases (transformation to a 1-mode network) on the basis of several network analysis' clustering methods: hierarchical clustering, VOS clustering and generalized blockmodelling, but mainly – Louvain communities' method



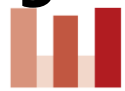
Method

In the analysis, we also use models from econometric analysis.

The regression methods we use are Poisson for the dependent variables of count nature (nr. of medical visits, nr. of taken medications, nr. of hospitalizations) and probit for the dependent variable of binary nature (probability of hospitalization).

We test the models for goodness of fit (deviance and Pearson statistic for Poisson; Hosmer-Lemeshow test for probit) as well as classification and sensitivity (only for probit).

Finally, we control for endogeneity in the model using a novel instrument.



Main variables

Has a doctor ever told you that you had/do you currently have any of the conditions on this card:

ph006d1 - A heart attack including myocardial infarction or coronary thrombosis or any other heart problem including congestive heart failure (0 – No, 1 – Yes);

ph006d2 - High blood pressure or hypertension (0 – No, 1 – Yes);

ph006d3 - High blood cholesterol (0 – No, 1 – Yes);

ph006d4 - A stroke or cerebral vascular disease (0 – No, 1 – Yes);

ph006d5 - Diabetes or high blood sugar (0 – No, 1 – Yes);

ph006d6 - Chronic lung disease such as chronic bronchitis or emphysema (0 – No, 1 – Yes);

ph006d10 - Cancer or malignant tumour, including leukaemia or lymphoma, but excluding minor skin cancers (0 – No, 1 – Yes);

ph006d11 - Stomach or duodenal ulcer, peptic ulcer (0 – No, 1 – Yes);

ph006d12 - Parkinson disease (0 – No, 1 – Yes);

ph006d13 - Cataracts (0 – No, 1 – Yes);

ph006d14 - Hip fracture (0 – No, 1 – Yes);

ph006d15 - Other fractures (0 – No, 1 – Yes);

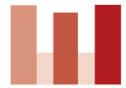
ph006d16 - Alzheimer's disease, dementia, organic brain syndrome, senility or any other serious memory impairment (0 – No, 1 – Yes);

ph006d18 - Other affective or emotional disorders, including anxiety, nervous or psychiatric problems (0 – No, 1 – Yes);

ph006d19 - Rheumatoid Arthritis (0 – No, 1 – Yes);

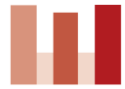
ph006d20 - Osteoarthritis, or other rheumatism (0 – No, 1 – Yes);

ph006other - Other conditions, not yet mentioned (0 – No, 1 – Yes).



Some descriptive statistics

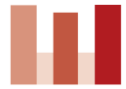
	ph006d1	ph006d2	ph006d3	ph006d4	ph006d5	ph006d6	ph006d10	ph006d11	ph006d12	ph006d13	ph006d14	ph006d15	ph006d16	ph006d18	ph006d19	ph006d20	ph006dot
AT	10.55%	41.41%	21.23%	5.16%	12.20%	5.69%	3.72%	3.89%	0.86%	9.01%	1.23%	5.33%	2.55%	4.80%	9.32%	5.93%	14.46%
DE	11.09%	41.65%	20.17%	4.84%	13.00%	7.74%	9.52%	4.17%	0.74%	10.14%	2.01%	11.09%	1.25%	7.86%	10.70%	19.15%	17.19%
SE	9.27%	38.92%	16.14%	5.53%	10.35%	4.14%	8.78%	3.49%	0.66%	12.61%	3.83%	6.08%	1.53%	4.98%	2.45%	20.23%	21.16%
NL	10.33%	29.11%	19.31%	3.37%	10.11%	8.88%	5.82%	1.79%	0.44%	6.57%	1.55%	4.66%	1.29%	3.71%	4.07%	16.74%	19.55%
ES	10.52%	37.86%	28.55%	2.42%	15.74%	5.97%	4.75%	3.68%	1.26%	9.03%	2.00%	5.73%	3.67%	7.88%	16.98%	10.32%	22.06%
IT	9.80%	40.80%	22.61%	3.26%	12.27%	5.81%	4.32%	3.28%	0.72%	6.64%	1.90%	4.24%	2.07%	5.92%	10.65%	18.25%	12.73%
FR	12.35%	32.38%	22.74%	3.14%	11.74%	6.03%	5.15%	2.55%	1.04%	6.87%	1.38%	3.93%	1.33%	6.48%	2.82%	34.69%	12.62%
DK	9.67%	35.13%	24.84%	3.71%	7.90%	7.29%	5.94%	3.17%	0.51%	8.21%	1.26%	6.57%	0.82%	4.65%	2.93%	23.92%	18.49%
CH	6.39%	28.96%	14.61%	1.80%	6.86%	3.89%	3.86%	1.17%	0.43%	6.86%	1.53%	2.80%	0.50%	3.89%	4.19%	19.37%	12.02%
BE	9.88%	33.13%	29.34%	2.89%	10.91%	6.36%	4.77%	5.75%	0.88%	7.25%	2.30%	5.02%	1.80%	7.41%	8.31%	23.72%	16.13%
IL	16.67%	43.59%	36.67%	5.49%	22.94%	6.05%	5.10%	4.62%	1.21%	13.13%	2.12%	5.57%	3.97%	4.32%	8.03%	5.40%	20.09%
CZ	12.91%	49.18%	24.16%	5.95%	18.74%	6.89%	5.46%	4.68%	0.95%	10.92%	2.24%	7.89%	1.02%	2.99%	13.89%	23.54%	15.11%
LU	10.89%	33.67%	34.35%	2.86%	12.63%	8.59%	9.89%	7.72%	0.93%	10.27%	2.92%	17.55%	1.37%	8.03%	9.58%	38.89%	13.38%
SI	14.17%	44.78%	21.54%	3.47%	12.98%	4.32%	4.28%	3.91%	0.68%	6.39%	1.29%	5.03%	2.28%	7.88%	8.63%	3.64%	16.31%
EE	17.64%	48.98%	19.88%	5.43%	12.27%	5.81%	4.74%	6.72%	1.03%	7.37%	1.37%	4.85%	1.47%	5.86%	13.37%	12.60%	15.21%
Total	**11.47%**	**39.16%**	**23.24%**	**4.03%**	**12.71%**	**6.24%**	**5.66%**	**4.03%**	**0.84%**	**8.67%**	**1.92%**	**6.12%**	**1.79%**	**5.82%**	**9.00%**	**18.16%**	**16.66%**



Variables in the analysis

Dependent variable	Description
Nr. of medical visits	Number of visits to a medical doctor or qualified nurse about respondents health (excluding dentist visits and hospital stays, but including emergency room or outpatient clinic visits)
Nr. of taken medications	Number of taken medications as a sum of answers to the following question: »Do you currently take drugs at least once a week for problems mentioned[2]?«
Nr. of hospitalisations	Number of hospitalisations in a hospital overnight during the last twelve months
Probability of hospitalisation	Response to the following question: »During the last twelve months, have you been in a hospital overnight? Please consider stays in medical, surgical, psychiatric or in any other specialised wards.«

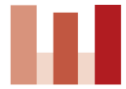
Table 2: Dependent variables used in the study



Variables in the analysis

Independent variable	Description
Gender	Male or female
Age	Four groups – 65-69 years; 70-74 years; 75-79 years; 80 and more years
EduYears	Years of education
Income	Total household income, classified into tertiles (low, middle, high) by individual country
Settlement	Living in an urban (encompassing: 1. A big city; 2. The suburbs or outskirts of a big city; 3. A large town; 4. A small town) or in a rural (A rural area or village) environment
LivingAlone	Binary variable, having the value of 1 if the respondent lives alone in a household and 0 otherwise
ChildDist	Binary variable, having the value of 1 if the respondent has a child living in the area of 25 km and 0 otherwise
Limited	Binary variable, having the value of 1 if the respondent is severely limited because of a health problem in activities people usually do and 0 otherwise

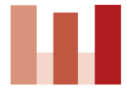
Table 3: Independent variables used in the study



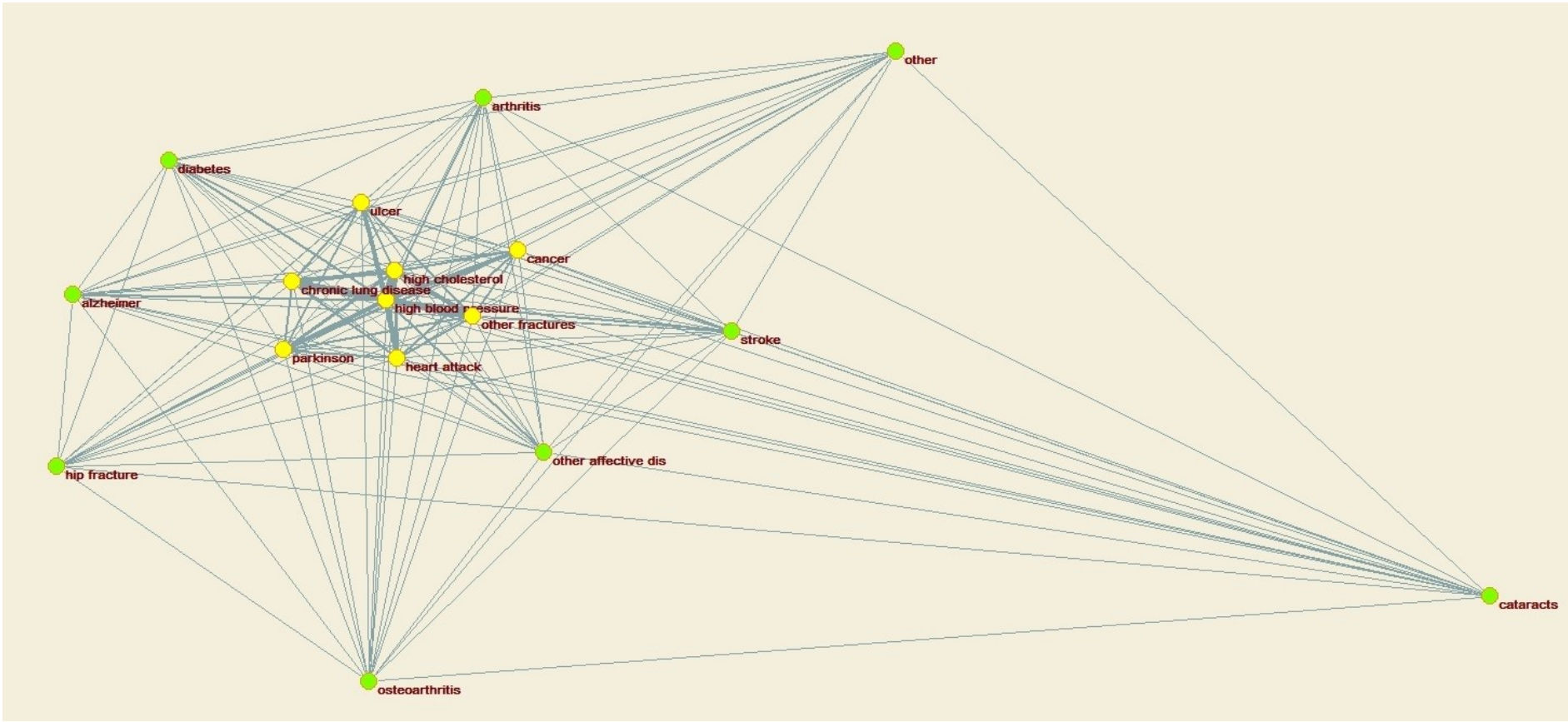
Results – network analysis

Frequencies of ties – valued/weighted network

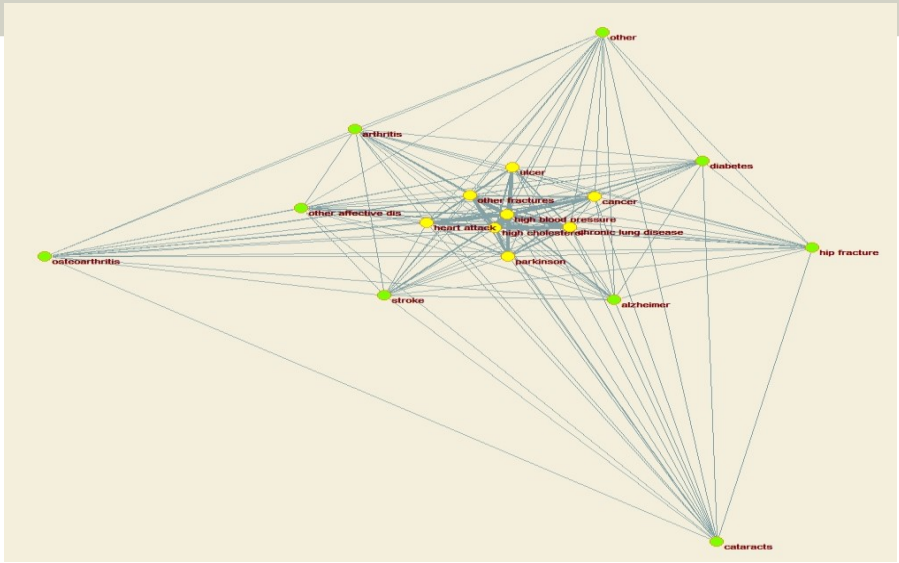
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Label
1.	0	3514	2324	763	671	1510	1090	1052	1345	253	560	1557	653	859	628	398	407	heart attack
2.	3514	0	6416	1383	1314	3805	2776	2486	2950	353	997	4090	1355	1527	1206	660	666	high blood pressure
3.	2324	6416	0	852	801	2483	1601	1504	1848	267	704	2521	889	963	822	452	419	high cholesterol
4.	763	1383	852	0	337	665	454	419	597	204	312	635	347	364	364	331	252	stroke
5.	671	1314	801	337	0	568	495	422	655	187	325	741	406	406	316	223	254	diabetes
6.	1510	3805	2483	665	568	0	983	1010	1219	244	448	1393	593	698	544	428	339	chronic lung disease
7.	1090	2776	1601	454	495	983	0	708	1010	205	420	1207	536	569	521	292	301	cancer
8.	1052	2486	1504	419	422	1010	708	0	1011	227	526	1539	547	593	570	333	328	ulcer
9.	1345	2950	1848	597	655	1219	1010	1011	0	250	528	1663	739	699	592	370	434	parkinson
10.	253	353	267	204	187	244	205	227	250	0	171	260	190	191	200	221	177	cataracts
11.	560	997	704	312	325	448	420	526	528	171	0	659	372	376	354	220	239	hip fracture
12.	1557	4090	2521	635	741	1393	1207	1539	1663	260	659	0	857	952	810	373	492	other fractures
13.	653	1355	889	347	406	593	536	547	739	190	372	857	0	440	381	231	331	alzheimer
14.	859	1527	963	364	406	698	569	593	699	191	376	952	440	0	418	271	253	other affective dis
15.	628	1206	822	364	316	544	521	570	592	200	354	810	381	418	0	355	232	arthritis
16.	398	660	452	331	223	428	292	333	370	221	220	373	231	271	355	0	220	osteoarthritis
17.	407	666	419	252	254	339	301	328	434	177	239	492	331	253	232	220	0	other

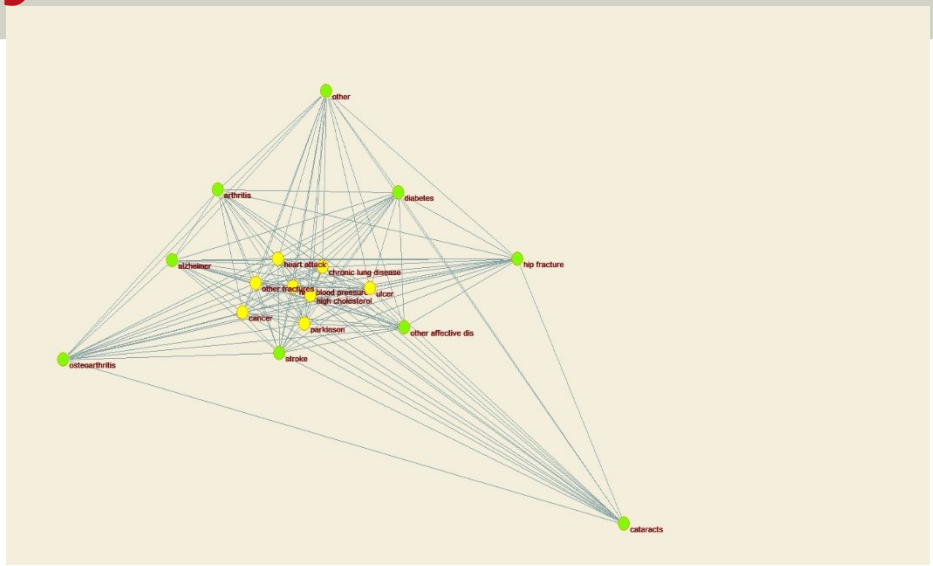


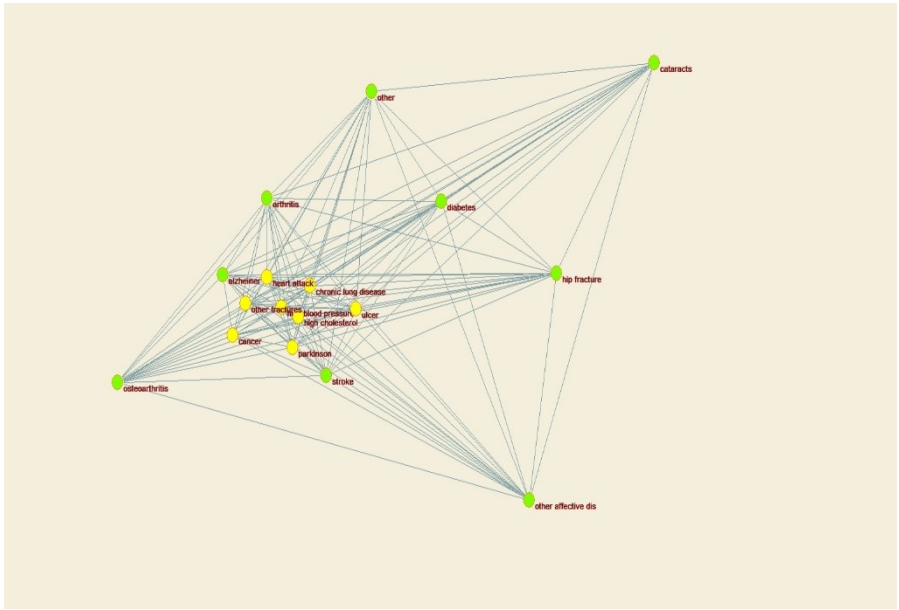
Results – network analysis, Louvain

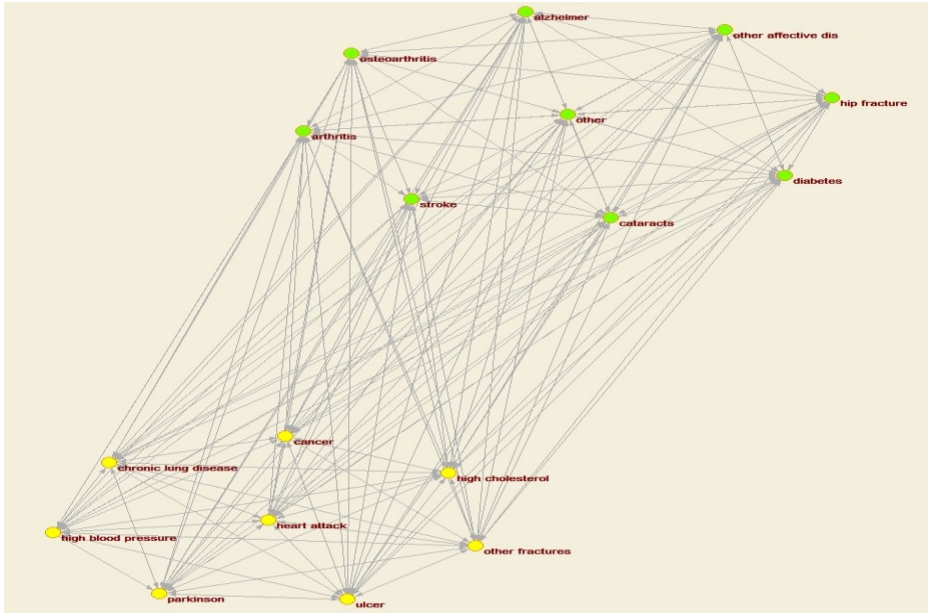


Results – network analysis, different methods

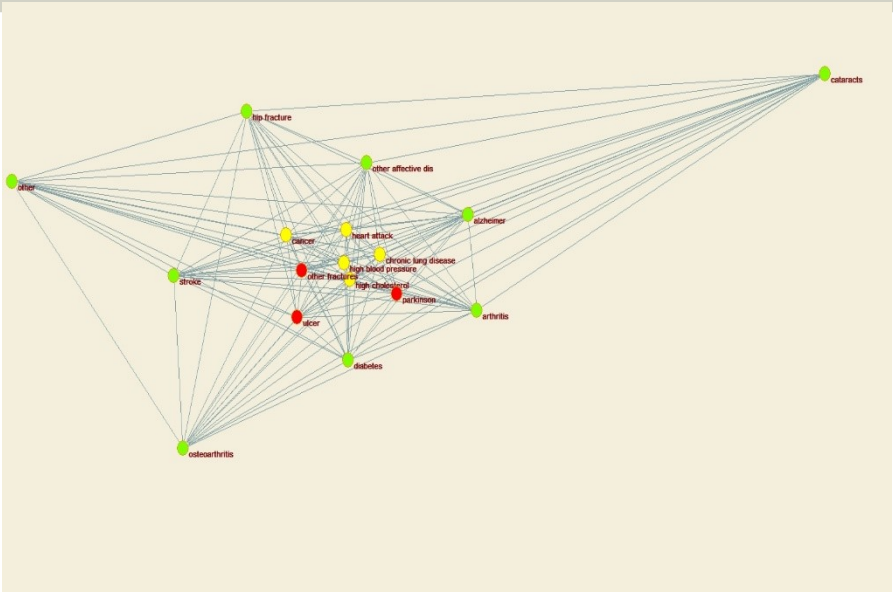


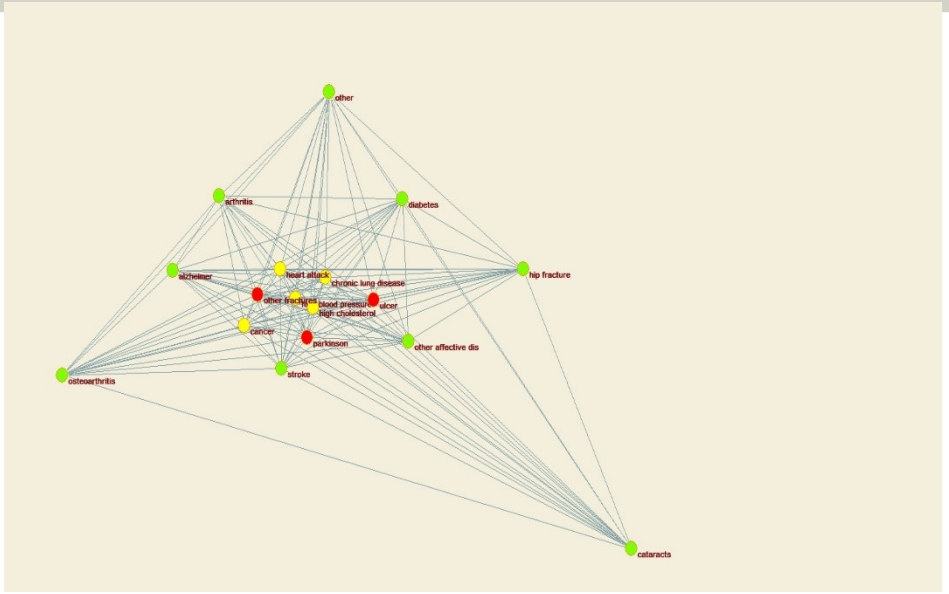


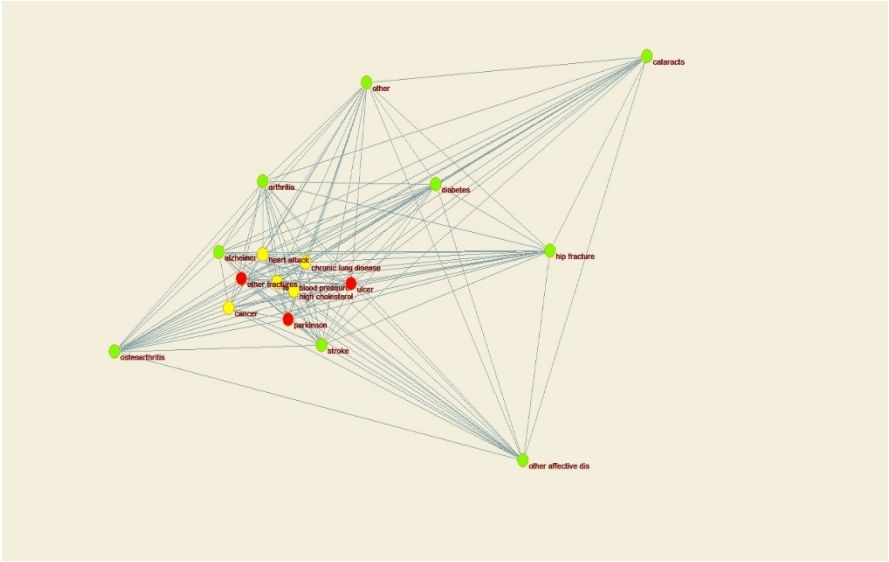


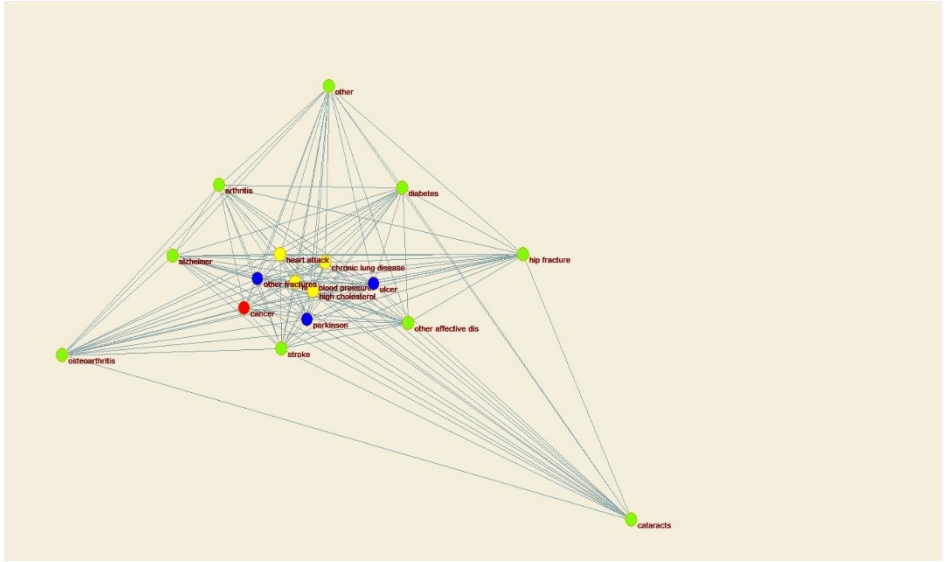


Results – network analysis, 3 clusters



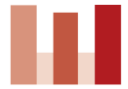






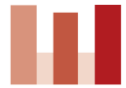
Results – network analysis

Group 0	Group 1
alzheimer	cancer
hip fracture	chronic lung disease
arthritis	heart attack
cataracts	high blood pressure
diabetes	high cholesterol
osteoarthritis	**Group 2**
other affective diseases	other fractures
stroke	parkinson
other diseases	ulcer



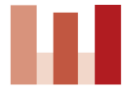
Results – descriptives

	NrMedVis	NrTakMed	NrHospit
cancer	12.95	2.42	4.82
chronic lung disease	11.81	3.27	4.27
heart attack	11.33	3.53	4.42
high blood pressure	8.51	2.74	2.26
high cholesterol	8.60	2.96	1.97
other fractures	9.91	2.47	3.67
parkinson	14.50	3.20	4.16
ulcer	10.72	3.21	3.08
Cluster1	8.47	2.46	2.36
Group 1	8.51	2.52	2.43
Group 2	7.70	1.43	1.35
alzheimer	12.48	3.37	5.42
arthritis	10.62	3.17	2.54
cataracts	10.09	2.92	3.09
diabetes	10.44	3.45	3.39
hip fracture	10.62	2.98	6.17
osteoarthritis	9.46	2.73	2.42
other affective dis	11.98	3.27	3.35
stroke	12.19	3.54	5.59
other diseases	9.24	2.30	2.72
Cluster0	4.57	0.79	0.92



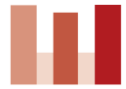
Results – econometric analysis

	Nr. medical visits			Nr. taken medications			Nr. hospitalizations			Prob. of hospitalization		
	Coeff	z	Sig	Coeff	z	Sig	Coeff	z	Sig	Coeff	z	Sig
Constant	1.5232	101.96	***	-0.0719	-2.48	**	-0.1916	-6.58	***	-1.3539	-22.05	***
Gender	0.0151	2.47	***	0.1138	9.81	***	-0.2200	-19.12	***	-0.0993	-3.88	***
Age 70-74	0.0835	10.36	***	0.0862	5.61	***	0.2521	15.45	***	0.0860	2.57	**
Age 75-79	0.1156	13.77	***	0.1580	10.01	***	0.1895	11.17	***	0.1058	3.00	***
Age 80+	0.0576	6.93	***	0.1722	11.16	***	0.3013	19.01	***	0.1553	4.53	***
Edu Years	-0.0029	-3.53	***	-0.0075	-4.94	***	-0.0057	-3.76	***	-0.0004	-0.12	
IncomeMid	-0.0230	-3.18	***	-0.0504	-3.74	***	0.0242	1.77	*	0.0131	0.43	
IncomeHigh	-0.0467	-5.58	***	-0.0760	-4.85	***	-0.0364	-2.27	**	0.0086	0.25	
Settlement	0.0145	2.30	**	0.0408	3.46	***	-0.0585	-5.03	***	-0.0228	-0.87	
LivingAlone	-0.0084	-1.25		-0.0039	-0.31		0.1279	10.05	***	0.0730	2.58	**
ChildDist	0.0452	6.95	***	0.0600	4.93	***	0.0618	5.06	***	0.0201	0.74	
Limited-GALI	0.5637	88.68	***	0.3991	33.33	***	1.4594	130.52	***	0.6309	22.72	***
Cluster1	0.4510	62.58	***	0.8318	54.85	***	0.5162	35.40	***	0.3241	11.50	***
Group 1	0.3981	54.71	***	0.7986	52.28	***	0.3924	10.82	***	0.2285	8.13	***
Group 2	0.2525	14.40	***	0.3455	9.33	***	0.4578	5.81	***	0.2342	3.35	***
Individual dis	Yes			Yes			Yes			Yes		
Nr. obs.	15629			15766			15763			15777		
LR chi2	14501.78	***		6273.41	***		22299.67	***		825.47	***	
Log Likelihood	-85278.90			-26647.35			-75718.49			-7114.86		
Pseudo R2	0.0784			0.1053			0.1284			0.0548		



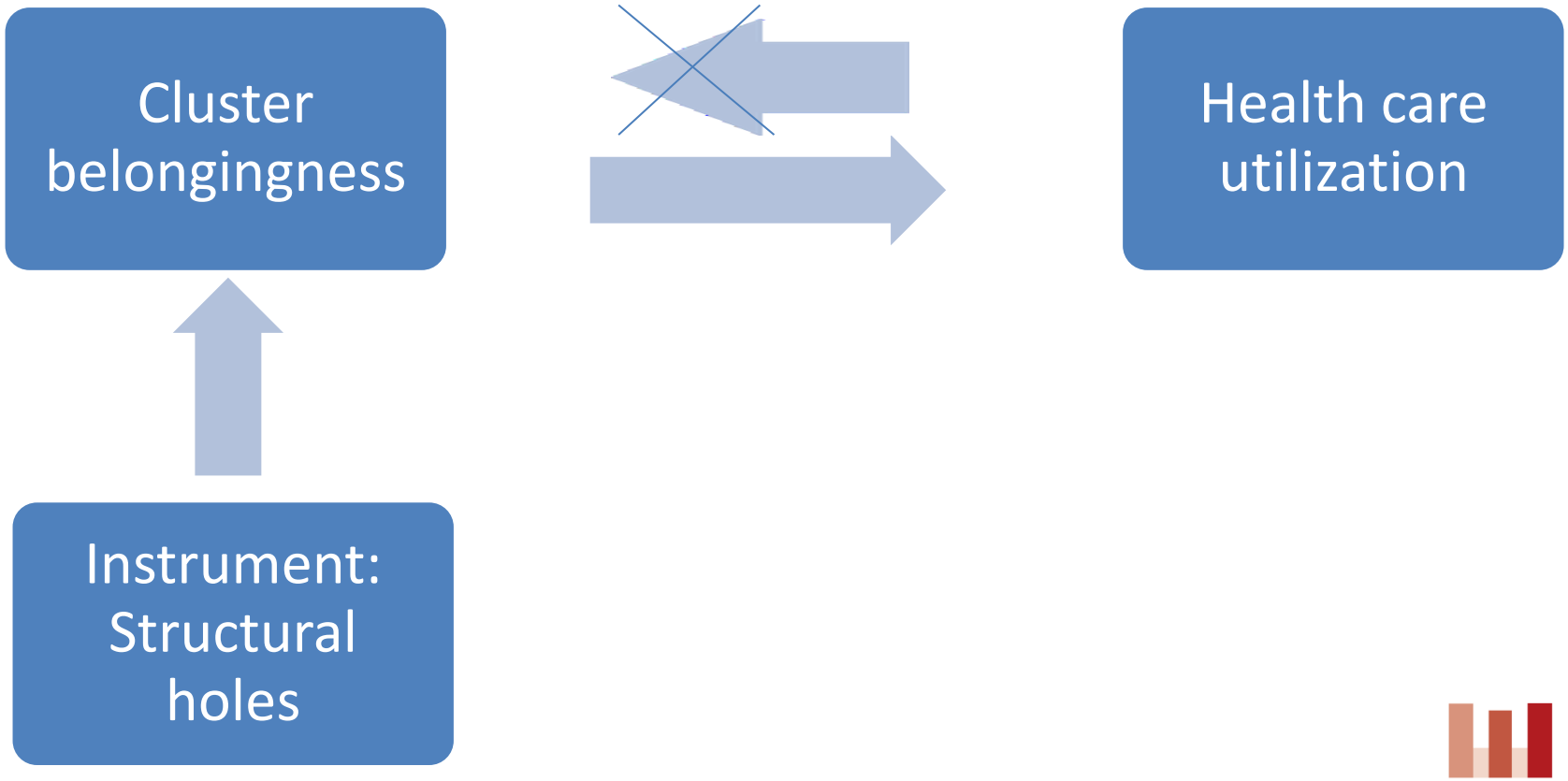
Results – econometric analysis, goodness-of-fit comparison

	Nr. medical visits		
	AIC	BIC	LogLik
Networks model	153868.5	153966.1	-80916.2
Netw 2 clust model	150791.1	152426.4	-79297.9
NrChronDis model	164406.0	164505.5	-92521.2
IndividDis model	163107.1	163329.1	-92457.6
	Nr. taken medications		
	AIC	BIC	LogLik
Networks model	48447.8	48545.5	-25423.7
Netw 2 clust model	47478.8	47574.6	-25169.4
NrChronDis model	50299.8	50399.4	-29782.6
IndividDis model	49284.3	49506.6	-29767.8
	Nr. hospitalizations		
	AIC	BIC	LogLik
Networks model	143468.6	143566.4	-80691.2
Netw 2 clust model	142033.9	142130.7	-78270.4
NrChronDis model	149070.4	149170.0	-86863.9
IndividDis model	144532.6	144754.9	-86839.8



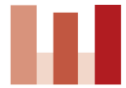
Results – econometric analysis

Also: omitted variables problem



Results – econometric analysis

	Nr. medical visits			Nr. taken medications			Nr. hospitalizations			Prob. of hospitalization		
	Coeff	z	Sig	Coeff	z	Sig	Coeff	z	Sig	Coeff	z	Sig
Constant	1.5968	10.72	***	0.1927	1.89	**	-0.2252	-0.67		-1.4635	-7.18	***
Gender	0.0284	1.22		0.1075	8.95	***	-0.2938	-3.47	***	-0.1099	-4.07	***
Age 70-74	0.0636	2.06	**	0.0684	4.22	***	0.1667	1.43		0.0563	1.54	
Age 75-79	0.0875	2.76	***	0.1308	7.84	***	0.1515	1.37		0.0770	2.00	**
Age 80+	0.0458	1.50		0.1490	9.28	***	0.3311	3.13	***	0.1331	3.71	***
Edu Years	-0.0033	-1.03		-0.0070	-4.46	***	-0.0008	-0.07		0.0004	0.11	
IncomeMid	-0.0275	-0.98		-0.0510	-3.69	***	-0.0788	-0.86		0.0097	0.31	
IncomeHigh	-0.0391	-1.24		-0.0734	-4.53	***	-0.1780	-1.76	*	0.0128	0.35	
Settlement	0.0082	0.34		0.0358	2.87	***	-0.1289	-1.41		-0.0245	-0.89	
LivingAlone	-0.0070	-0.27		-0.0006	-0.04		0.1699	2.11	**	0.0711	2.40	**
ChildDist	0.0425	1.66	*	0.0560	4.34	***	0.0495	0.53		0.0235	0.83	
Limited-GALI	0.5122	19.41	***	0.3662	28.40	***	1.4000	19.16	***	0.5958	18.94	***
Cluster1	0.4535	2.39	**	0.6117	4.82	***	0.8058	2.22	**	0.5259	1.94	*
Nr. obs.	15629			15766			15763			15777		



Discussion and Conclusion

In our analysis, we tested a new method to model the presence of multiple co-existing chronic diseases in individuals: network analysis, based on SHARE data.

The method provided us an insight into the connections and groupings of diseases for the case of 65+ population in SHARE countries and we were able to observe two main groupings based on connectivity and structure of the network.

We were also able to observe the effects of such a classification for the relationship to health care utilization and confirmed that by including the groupings of diseases the fit of the model is significantly improved than by including only general variables or separate variable for each disease.

Discussion and Conclusion

Although the article is at this stage exploratory and we are still testing for the results of using a »new« (in terms of previous usage for modelling this problem) method, it is already clear that implications of such approach can be very rich, for both geronthology (if using SHARE data), health economics and medicine sciences in general.

Using improved clustering and classification methods (still under work), already existing for network analysis can provide significant new insights into 1) the groups of diseases that are linked – when using SHARE data we are of course talking about the chronic diseases of the older people; and 2) their effects for different variables in the system, including the health policy variables – organization of the system and costs and their projections in future.

At this point we are able to say that the work on the method in future will provide us with a more developed insights into the problem and in terms of methodological possibilities.

THANK YOU FOR LISTENING!

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