Measuring comorbidity when analysing cancer data

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Aims of presentation

- Describe routine data sources in Scotland and how they can be used to routinely measure comorbidity
- Compare disease-specific measures compared to measures that attempt to look at the overall burden of disease
- Discuss the pro's and con's of these approaches

SMR01 Hospital discharge data

Episode-based records relating to all hospital discharges (or transfers)

- Principal diagnosis
- (Up to) 5 secondary diagnosis codes
- Operations and procedures
- Locations and transfers
- Referral types
- Waiting times
- Specialties
- Personal identifiers

Similar to HES data in England

Secondary diagnosis fields

- A record of active problems related to the admission
- A record of background comorbidities from the list below

Solid Metastases C77 - C79	Cardiac Arrythmias I44 - I45, I47 - I49
Chronic Pulmonary Disorders J40X - J67, J684, J701, J703	Dementia F00* - F03X, G30
Heart Failure / Cardiomyopathy I110, I130, I132, I42 - I43*, I50 I517	Obesity E66
Malignancies C00 - C76, C80X - C97X	Valvular Heart Disease I05 - I08, I34 - I39*, Q23
Pulmonary Circulation Disorders I27 - I28	Coagulopathy D66 - D69
Peripheral Vascular Disease I70 - I71, I73, I790*, I792*, K551 - K559	Drug/Alcohol Abuse F10 - F19
AIDS / HIV B20 - B24X	Hemiplegia / Paraplegia G80 - G83
Cerebrovascular Disease I65 - I69	Other Neurological Disorders G10 - G13*, G31 - G40
Ischaemic Heart Disease I20, I25	Renal Disease N03, N05, N11 - N12X, N18 - N19X, N25
Diabetes E10 - E14	Nutritional Anaemia D50 - D53
Liver Disease B18, I85, I864, I982*, K70 - K76	Hypertension, Uncomplicated I10X
Hypertension, Complicated I119, I12, I131, I139, I15	Psychoses F20 - F29X, F31
	Malnutrition / Weight Loss E40X - E46X, R634, R64X

See details at http://www.isdscotland.org/isd/files/SMR01%20Other%20Conditions%20-%20coding%20guidance.doc

Accuracy of the SMR01 (discharge) data

Database field	% accuracy
Surname	99.8
Date of birth	99.7
Postcode	90.0
Date of admission	99.2
Date of discharge	97.9
Principal diagnosis	87.9 (range 70-98%)
Secondary diagnoses	72.2 *

Source: Towards Better Data from Scottish Hospitals: An Assessment of SMR01 and Associated Data 2004 - 2006 (published 25/09/07)

* Mainly due to under-recording

The Scottish linked database

- SMR01 hospital discharge records (1981-2008)
- SMR06 cancer registrations (1980-2007*)
- GROS death registrations (1981-2008)
- SMR04 Psychiatric records

All linked routinely (monthly) using probability matching.

Comprises almost 34 million records

Scottish linked database: example

Record Type	Date of admission	Type of admission	Health Board	Hospital	Specialty	Principal Diagnosis	Date of discharge
SMR1	30-Mar-96	Emergency	Lothian	Edinburgh R.I.	General Surgery	Appendicitis	08-Apr-96
SMR1	04-Dec-96	Elective	Lothian	Edinburgh R.I.	Ophthalmology	Cataract	06-Dec-96
SMR1	09-Sep-98	Emergency	Lothian	Edinburgh R.I.	General Medicine	AMI	10-Sep-98
SMR1	10-Sep-98	Transfer	Lothian	Edinburgh R.I.	Cardiology	AMI	15-Sep-98
SMR1	15-Sep-98	Transfer	Lothian	Edinburgh R.I.	Geriatric Medicine	AMI	23-Sep-98
SMR1	22-May-03	Elective	Lothian	Western General	General Surgery	Stomach Cancer	24-May-03
Cancer	24-May-03	Registration for stomach cancer					
SMR1	29-Jun-04	Emergency	Lothian	Edinburgh R.I.	Geriatric Assessment	AMI	30-Jun-04
Death	09-Sep-04	Cause of death: AMI					

Measuring comorbidity

Evaluation of comorbidity in cancer patients at time of cancer diagnosis:

- The Charlson index (which looks for the presence of 19 diseases in a defined period (e.g. 2 years). Different weights are attached to each disease and a slightly modified version can be used on electronic data)

  To take account of impact of specific diseases

- The beddays index (the number of days spent in hospital in a defined period. For example, the period 2 years to 3 months prior to the cancer diagnosis was used)

  To try to estimate the accumulated effects of ill health

Bed-days comorbidity index

- Looked at all bed-days in
  - The 6 months prior to diagnosis
  - The 6 months to 2 years prior to diagnosis
- Split into bands of time
  - No bed-days
  - 1-10 bed-days
  - 11-29 bed-days
  - 30+ bed-days

Bed-days index: risk of death within 2 years of diagnosis
(selected cancers)

Bed-days percentile	All preceding bed-days	All preceding non-cancer bed-days	Preceding bed-days within 2 years		
			All patients	Ages 60-69	Stage adjusted
25th	1.00	1.00	1.00	1.00	1.00
50th	0.94	0.97	0.93	0.65***	1.13
75th	1.03	0.97	1.10*	0.82**	1.06
90th	1.19**	1.21***	1.21**	1.33***	1.18*
95th	1.71***	1.65***	1.77***	2.05***	1.61**

Where *:$p<0.05$, **:$p<0.01$, ***: $p<0.001$

Example of data analysed

- 2,500 cases of breast cancer diagnosed in Scotland on cancer registry
- 26,252 SMR01 (discharge) records linked to these breast cancer patients
  - Range (1-112 SMR01s per individual)
  - 63 patients had >30 SMR01s
- 467 of these breast cancer patients died within 2 years of diagnosis

Levels (%) of comorbidity

Comorbidity	Breast	Colon	Rectum	Kidney	Bladder
Bed-days					
None	82	75	78	72	77
1-10	13	17	16	21	16
11-29	4	6	3	5	5
30+	1	3	3	2	2
Charlson					
No conditions	93	85	86	86	88
1 or more conditions	7	15	14	14	12

Adjusted crude 2-year survival

Comorbidity	Breast	Colon	Rectum	Kidney	Bladder
Bed-days					
None	83.4	54.3	59.6	48.9	65.2
1-10	86.0	51.7	62.7	60.8	63.3
11-29	69.0	44.1	34.5	45.8	60.0
30+	52.2	24.6	26.1	33.3	37.5
Charlson					
No	84.8	55.8	61.3	53.5	66.4
Yes	54.4	33.1	40.2	34.8	46.8

Note: Adjusted for age band and sex

Multivariate survival: breast cancer

Index	Level	H.Ratio	P-value
Bed-days 6-24m	None	1.00	
	1-10	0.80	*0.107*
	11-29	1.38	*0.066*
	30+	1.71	*0.016*
Charlson	No		
	Yes		
Bed-days 0-6m	None		
	1-10		
	11-29		
	30+		

Multivariate survival: breast cancer

Index	Level	H.Ratio	P-value	H.Ratio	P-value
Bed-days 6-24m	None	1.00		1.00	
	1-10	0.80	*0.107*	0.72	*0.018*
	11-29	1.38	*0.066*	0.99	*0.959*
	30+	1.71	*0.016*	1.15	*0.557*
Charlson	No			1.00	
	Yes			1.58	*0.003*
Bed-days 0-6m	None				
	1-10				
	11-29				
	30+				

Multivariate survival: breast cancer

Index	Level	H.Ratio	P-value	H.Ratio	P-value	H.Ratio	P-value
Bed-days 6-24m	None	1.00		1.00		1.00	
	1-10	0.80	*0.107*	0.72	*0.018*	0.56	*<0.001*
	11-29	1.38	*0.066*	0.99	*0.959*	0.75	*0.190*
	30+	1.71	*0.016*	1.15	*0.557*	0.71	*0.208*
Charlson	No			1.00		1.00	
	Yes			1.58	*0.003*	1.36	*0.056*
Bed-days 0-6m	None					1.00	
	1-10					1.30	*0.268*
	11-29					3.21	*<0.001*
	30+					2.94	*0.001*

Multivariate survival: colon cancer

Index	Level	H.Ratio	P-value	H.Ratio	P-value	H.Ratio	P-value
Bed-days 6-24m	None	1.00		1.00		1.00	
	1-10	1.07	*0.425*	0.98	*0.781*	0.86	*0.299*
	11-29	1.10	*0.460*	0.88	*0.326*	0.74	*0.089*
	30+	1.92	*<0.001*	1.41	*0.026*	1.21	*0.330*
Charlson	No			1.00		1.00	
	Yes			1.45	*<0.001*	1.44	*<0.001*
Bed-days 0-6m	None					1.00	
	1-10					1.02	*0.917*
	11-29					1.24	*0.190*
	30+					1.44	*0.064*

Multivariate survival: rectal cancer

Index	Level	H.Ratio	P-value	H.Ratio	P-value	H.Ratio	P-value
Bed-days 6-24m	None	1.00		1.00		1.00	
	1-10	0.82	*0.179*	0.70	*0.022*	0.59	*0.009*
	11-29	1.57	*0.060*	1.04	*0.877*	0.83	*0.571*
	30+	1.63	*0.059*	1.11	*0.708*	0.87	*0.669*
Charlson	No			1.00		1.00	
	Yes			1.30	*0.170*	1.24	*0.259*
Bed-days 0-6m	None					1.00	
	1-10					1.18	*0.544*
	11-29					1.40	*0.294*
	30+					2.70	*0.004*

Multivariate survival: kidney cancer

Index	Level	H.Ratio	P-value	H.Ratio	P-value	H.Ratio	P-value
Bed-days 6-24m	None	1.00		1.00		1.00	
	1-10	0.70	*0.040*	0.56	*0.002*	0.27	*<0.001*
	11-29	0.97	*0.907*	0.73	*0.301*	0.38	*0.015*
	30+	1.61	*0.195*	1.23	*0.588*	0.65	*0.333*
Charlson	No			1.00		1.00	
	Yes			1.29	*0.247*	1.37	*0.167*
Bed-days 0-6m	None					1.00	
	1-10					2.74	*0.008*
	11-29					2.23	*0.037*
	30+					5.66	*<0.001*

Multivariate survival: bladder cancer

Index	Level	H.Ratio	P-value	H.Ratio	P-value	H.Ratio	P-value
Bed-days 6-24m	None	1.00		1.00		1.00	
	1-10	1.07	*0.616*	0.98	*0.853*	0.77	*0.185*
	11-29	1.01	*0.968*	0.81	*0.343*	0.46	*0.008*
	30+	1.37	*0.240*	1.02	*0.932*	0.62	*0.148*
Charlson	No			1.00		1.00	
	Yes			1.65	*0.005*	1.66	*0.005*
Bed-days 0-6m	None					1.00	
	1-10					1.08	*0.758*
	11-29					2.18	*0.004*
	30+					3.93	*<0.001*

Pro's of methods

- Readily available information from the Scottish linked file – cheap and easy!
- Hospital comorbidity is a strong predictor of cancer patient survival, independent of age, for all the cancers investigated.
- Bed-days – although very crude – appears to be robust; and doesn't rely on coding

Con's of methods

- Difficult to do if linked hospital/cancer data is not available.

- No information on severity of diseases
- Under-reporting of secondary diagnoses

Although the measures are still useful markers despite these reservations

Conclusions

- The strongest marker of comorbidity is bed-days in the 6 months preceding diagnosis, but this is not always easy to interpret.
  - For diseases where clinical diagnosis may difficult to achieve quickly, it may be important to exclude bed-days in the 6 months preceding the diagnosis
- When the bed-days in the 6 months prior to diagnosis is excluded, impact of specific diseases gains importance.
- The "best" measure differed by cancer type, so any comprehensive hospital-based comorbidity index will have to take into account both the impact of specific diseases and the accumulated effects of ill health.