

ORIGINAL ARTICLE

Co-morbidity in general practice

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Background: Co-morbidity, or the presence of more than one clinical condition, is gaining increased attention in epidemiological and health services research. However, the clinical relevance of co-morbidity has yet to be defined. In general practice, few studies have been conducted into co-morbidity, either at a single health care encounter, an episode of care, or for a defined time period.

Aims: To describe the major co-morbidity cluster profiles recorded by general practitioners. Another aim of this study is to describe the common clusters of co-prescribing.

Methods and results: Twelve month data from patients attending 156 GPs from 95 practices around a six month period of January to June 2003 were analysed. This represented 840 961 encounters from about 200 000 individual patients at these participating practices. Co-morbidity and co-prescribing cluster profiles are represented by problems managed and reasons for prescribing for the top 10 presentations and top 10 prescribed drugs in the study period.

Conclusions: By analysing the 10 most prevalent problems and 10 most prevalent drugs prescribed in consultations in a community sample, other co-morbidities that are particular to general practice, for example hypertension and lipid disorders, can be uncovered. Whether these clusters are causally related or occur by chance requires further analysis.

Co-morbidity, defined as the presence of other clinical conditions in the presence of a condition, is gaining increased attention as a potential confounder in epidemiological research.¹ Hospital based studies have suggested that co-morbidity restricts the external validity of results from single disease intervention studies and complicates the organisation of care.² In Australia, a study using a linked file of 1.2 million hospital morbidity records and death registrations described an almost sevenfold increase in costs/per patient/year between patients with one of five index health priority areas and those patients with all five co-morbidities.³ Other studies have also reported high co-morbidity specifically in mental health.⁴ Researchers have also suggested that a potential interaction of major depressive disorders and cardiovascular disease may influence health outcomes beyond the impact of individual disease or problem entities.⁵

Some argue that co-morbidity is the rule rather than the exception and that this ought to influence our approaches to quality of care.⁶ One literature review found that, although often mentioned as a consequence, the issue of co-morbidity was seldom the main focus of studies. Despite this lack of focus, the reviewers determined that in general, co-morbidity influenced a range of health outcomes including mortality, quality of life, and health care utilisation.⁷

In general practice, the few studies that have been conducted, have explored co-morbidity at a single health care encounter or episode of care. A Dutch study, identified an average of 1.6 problems per encounter.⁸ In a USA study, the number of visits for co-morbid conditions to both primary care physicians and to specialists exceeded the number of visits for the index condition in almost all co-morbidity groups.⁹ In Australia, the BEACH study reported that in nearly one third of general practice consultations more than one problem was managed per consultation.¹⁰ These data suggest that co-morbidity is a significant factor in episodic patient care.

Recently the focus on co-morbidity has been to quantify its effect from a population perspective. To that end, major co-morbidity clusters have been described from large hospital

based data collections and several scales developed to determine the impact of co-morbidity in populations over disease triggered episodes of care.^{11–15} It is not known whether these clusters apply to general practice settings where care is both continuing and episodic. One study has suggested that co-morbidity may differ between hospital and community settings.¹⁶ The key aim of this project is to describe the major co-morbidity cluster profiles recorded by general practitioners over a fixed time period.

Integrally linked to co-morbidity is co-prescribing. A recent study on appropriateness of prescribing in general practice showed a complex picture as to whether prescribed medicines were wanted, necessary, and appropriate.¹⁷ The authors concluded that the impact of co-morbidities and co-prescribing would need to be taken into account in further studies. Another aim of this study is to describe the common clusters of co-prescribing that may need to be taken into account.

METHODS

Data collection

The General Practice Research Network (GPRN) is a sample of the 14 500 Australian GP users of the electronic patient management system *Medical Director*.¹⁸ The GPRN aims to maintain an active sample of 300 GPs with replacement of drop outs. Longitudinal de-identified patient data dating back to 1 January 1999 when available are extracted and provided electronically to the research team on an ongoing basis. Participating GPs are electronically locked into recording a reason for prescription and/or a reason for visit. In essence, the GPs form part of an ongoing prospective observational cohort of GPs. Data are captured from the electronic patient record for patient demographics; prescribing; reasons for prescribing; reasons for visit; patient history; pathology and radiology requests; and clinical measurements, for example, blood pressure, height, and weight.

Statistical analyses

The analyses, rate per 1000 patients, were carried out in May 2004 through SAS (SAS Institute, Cary, NC) on data

Table 1 Characteristics of the GPRN GP cohort and Australian GPs

	GPRN GPs		Australian GPs	
	Number	%	Number	%
Sex				
Female	46	29.5	6955	36.6
Male	110	70.5	12029	63.4
Age (y)				
<35	19	12.9	2243	11.8
35–44	54	35.3	5639	29.7
45–54	44	28.8	6142	32.4
55+	36	23.5	4960	26.1
Missing	3			
Total	156		18984	

Source: Australian GP Distribution 2003 provided by HIC.

generated by GPs from practices where all GPs were participating. Analyses included data only from these practices that had provided data covering their activity for the full study period of 1 July, 2002 and 31 December, 2003. Data from patients attending GPRN GPs during the period from 1 January 2003 to 30 June, 2003 (recruitment period) were investigated for co-morbidity (represented by problems managed and prescription drugs in consultations where drugs were prescribed) for the duration of the study period. The rates per 1000 patients were determined for the 10 most frequent problems managed and 10 most frequent generic drugs prescribed were determined for the study period.

RESULTS

GP characteristics

There were 156 GPs from 95 practices with data for the defined study period. This represented 840 961 encounters from about 200 000 different patients at these participating practices. There seems to be a sex difference between GPs for those GPRN participants in this analyses and all GPs in Australia for the corresponding period (table 1), with a greater proportion of male GPs in the cohort. While, not mathematically representative, the cohort is distributed across rural and urban Australia with 25.0% of participants from four states: New South Wales ($n = 39$), 30.1% from Victoria ($n = 47$), 22.4% from South Australia ($n = 35$), 9.0% from Queensland ($n = 14$), and the remaining states representing 13.5% of participants ($n = 21$). There were 53.2% ($n = 83$) of the GPs who practised in an urban area, while 46.8% ($n = 73$) practised in a rural or remote centre.

Co-morbidity: problems managed

GPs using *Medical Director* can record patient morbidity data in terms of the disease, symptom or complaint, reasons for prescribing, reasons for visits, social problem or ill defined condition managed at the encounter. This study refers to these collectively as “problems managed”. Doctors are able to select from a controlled medical vocabulary pick list, or insert free text in a separate field to record conditions, reasons for visits, and/or prescribing. The medical vocabulary (DOCLE) used by *Medical Director* has been mapped to ICPC2,¹⁹ a recognised international standard for classification of primary care, to provide comparative data to other general practice data collection systems. Analysis of our cohort of GPs resulted in 1 105 097 individual problems managed. The 10 most frequent problems managed accounted for 34.1% of all problems managed.

Table 2 shows a range of co-morbidity profiles presented as a rate per 1000 patients. Co-morbidity of problems managed have been described by the number of problems with decreasing frequency until each of the top 10 individual morbidities were included in at least one cluster. The frequencies range from the most frequent two problem cluster patient who has been diagnosed with hypertension and lipid disorder who would be expected to be seen by a GP each week, to the least frequent seven problem cluster patient with hypertension, asthma, depression, dermatitis, lipid disorder, oesophageal disorder, osteoarthritis and diabetes, one of whom would be seen about eight times a year.

Drugs prescribed

Prescription data collected through the GPRN are classified to the anatomical therapeutic chemical (ATC) classification system as well as trade name, strength, form, and pack size.²¹ The 10 most frequent generic drugs prescribed represent 23.3% of all drugs prescribed in consultation where drugs were prescribed. For the current cohort of GPs, there were 1 021 676 prescription records for the study period.

Over the study period, the major cluster profiles of individual drugs in table 3 highlight the frequency of same class prescribing. In the more prevalent clusters, this is particularly evident for pain relievers and antibiotics. The ATC classification system allows for the exploration of issues of co-morbidity related to possible co-prescribing, for example the use of multiple therapeutic classes of drugs for pain relief or inflammation (table 4).

DISCUSSION

This paper describes the initial results from the first review of data on co-morbidity from a major Australian longitudinal study conducted in general practice where index conditions were not specified. The cluster profiles of problems managed and drugs prescribed reinforce some of the well described patterns ascertained from hospital databases where index conditions are used such as hypertension and diabetes clusters, osteoarthritis and oesophageal disorders. Starfield has suggested that the significance of co-morbidity clustering may be more related to the clinical setting. Using the Johns Hopkins adjusted clinical groups to measure co-morbidity in a hospital primary care population, Starfield concluded that co-morbidity varied within each diagnosis. She also found that co-morbidity had an organisational component in that resource use depended on the degree of co-morbidity rather than the diagnosis.²¹

By analysing the 10 most prevalent problems and the 10 most prevalent prescribed drugs in a community sample,

Table 2 The most frequent patient co-morbidity clustering profiles: problems managed (ICPC2)*

Problems†	URTI (R74)‡	Hypertension (K86)	Asthma (R96)	Depression (P76)	Dermatitis (S88)	Lipid disorder (T93)	Oesophageal disease (D84)	Sleep disturbance (P06)	Osteoarthritis (L91)	Diabetes (T90)	Per 1000 patients
2	•										13.9
2	•	•									8.3
2	•				•				•		7.8
2	•							•			6.4
2	•			•							4.5
2	•					•				•	4.4
3	•					•					4.2
3	•					•			•		3.6
3	•					•	•				2.8
3	•					•			•		1.9
3	•							•			1.7
3	•				•						1.6
3	•				•						1.5
3	•	•			•						1.4
3	•										1.3
3	•				•				•		1.3
3	•								•		1.3
3	•										1.1
4	•			•			•				1.2
4	•										1.1
4	•									•	0.9
4	•										0.7
4	•							•			0.7
4	•				•						0.7
4	•										0.6
5	•									•	0.5
5	•				•						0.3
5	•										0.3
5	•										0.3
5	•			•							0.2
5	•				•						0.2
5	•				•						0.2
5	•										0.2
5	•										0.2
6	•		•								0.2
6	•			•							0.1
6	•										0.1
6	•	•									0.1
6	•									•	0.1
7	•										0.1
7	•										0.1
7	•										<0.1
Per 1000 patients	50.5	40.0	24.0	18.7	16.4	13.9	13.2	12.1	10.0	5.9	

*Problems contributing to each co-morbidity profile cluster are marked with “•”. †Co-morbidity profiles have been reproduced in decreasing order of frequency until a cluster containing each of the top 10 problems is identified to the level of seven problem clusters. ‡ICPC 2 code.

Table 3 The most frequent patient co-morbidity clustering profiles: prescribed drugs—generic compounds*

Drugst	Amoxicillin	Cephalexin	Paracetamol	Salbutamol	Atorvastatin	Temazepam	Diazepam	Tramadol	Amoxicillin/ Clavulanate	Paracetamol/Codaine	Per 1000 patients
2			•						•		24.2
2	•			•					•		23.3
2	•		•								6.8
2	•		•								6.6
2		•									6.2
2		•	•			•			•		4.9
2		•	•								4.8
2		•	•								4.7
2		•	•					•			3.9
2		•	•								3.1
2		•	•								2.8
2	•		•		•						2.5
3	•		•				•		•		4.9
3	•	•	•							•	4.2
3	•	•	•					•		•	4.0
3	•	•	•			•				•	4.0
3	•	•	•						•		3.9
3	•	•	•						•		3.0
4	•		•		•				•		2.8
4			•				•				1.3
4			•			•					1.3
4			•			•					1.2
4	•		•						•		1.1
4	•	•	•								1.0
4	•	•	•						•		0.9
4	•	•	•						•		0.9
4	•	•	•					•			0.9
4	•	•	•						•		0.9
4	•	•	•						•		0.8
4	•	•	•						•		0.8
4	•	•	•						•		0.7
4	•	•	•						•		0.7
5	•		•		•						0.9
5	•	•	•						•		0.8
5	•	•	•						•		0.7
5	•	•	•			•			•		0.6
5	•	•	•			•	•		•		0.5
5	•	•	•						•		0.5
5	•	•	•		•				•		0.5
6	•	•	•						•		0.5
6	•	•	•			•			•		0.3
6	•	•	•			•			•		0.3
6	•	•	•			•			•		0.2
6	•	•	•				•		•		0.2
6	•	•	•				•		•		0.2
6	•	•	•				•		•		0.2

Table 3 Continued

Drug†	Amoxicillin	Cephalexin	Paracetamol	Salbutamol	Atorvastatin	Temazepam	Diazepam	Tramadol	Amoxicillin/ Clavulanate	Paracetamol/Codeine	Per 1000 patients
6	0.2
6	0.1
7	0.1
7	0.1
7	0.1
7	0.1
7	0.1
Per 1000 patients	46.1	29.9	26.1	21.7	21.6	12.8	8.6	7.5	<1	<1	0.1

*Prescribed medications contributing to each co-prescribing profile cluster are marked with “.”. †Co-morbidity prescribing based on prescribed generic compounds have been reproduced in decreasing order of frequency until a profile containing each of the top 10 that have frequencies above 0 have been identified.

other co-morbidities that are particular to general practice, for example hypertension and sleep disturbance, can be uncovered. Whether these clusters are causally related or occur by chance requires further analysis. In a Dutch community general practice study on co-morbidity, prior and posterior probabilities for each co-morbidity between each combination of two ICPC rubrics were calculated. Cluster co-morbidity was illustrated for five chronic conditions; ischaemic heart disease, essential hypertension, arthroses, asthma, and diabetes mellitus.²² In addition, clustering was shown around two other problems; ear conditions and psychological disorders. Our data show some similarities at the level of two rubric clusters.

The analysis of the interrelations of larger cluster profiles is more problematic and may require different analytical techniques. Our study was limited to prior probabilities. A comparative study in a country where ICPC is also used, and where posterior probabilities can be calculated, would be a useful next step. At present, our co-morbidity clustering data serve to highlight the complex issues surrounding the management of chronic conditions in general practice and as does the co-prescribing data.

There are several other limitations to the study. The data on prescription drugs have not been linked to the co-morbidity cluster profiles, or as to whether the prescribing in the study period was for new or ongoing conditions. The sequential prescribing of antibiotics or analgesics, for example, may represent the management of several unrelated problems or the repeat management of a chronic problem. Further iteration of the database is required to answer these questions.

Future projects will seek to inform practice in the critical area of management and appropriate prescribing. Should the co-morbidity and co-prescribing cluster profiles prove to be clinically significant, these data can be incorporated into clinical patient management software packages, to act as a prompt to clinicians to check for relevant conditions and as a decision support for co-prescribing. For example, as a major co-morbidity cluster profile was hypertension, diabetes, and osteoarthritis, this information can be used to trigger a check for a related clinical problem such as obesity or a potential co-prescribing problem such as the concomitant use of antihypertensive drug and a non-steroidal anti-inflammatory drug (NSAID) where the NSAID may impair the antihypertensive effect. Current decision support resources or tools such as management guidelines rarely address issues of co-morbidity, let alone how to determine priorities in management between co-morbid conditions in an individual patient.

Another limitation of the study is the representativeness of the database. Our cohort of practices relies heavily on smaller practices, and while there seems to be good coverage across Australia for the analysis, there is a possibility that the results may be biased towards the larger states and rural areas.

This study outlines one method for viewing co-morbidity that is not based on a unique index condition. Many questions remain unanswered. For example, little is known about the impact of a number of co-morbidities in one patient on what a GP prescribes for them compared with another patient. A patient who has hypertension, osteoarthritis, and obesity at one consultation might need to receive a different range of drugs and treatment advice than a patient who has a different cluster of co-morbidities accompanying their hypertension. Other factors may influence prescribing in a longitudinal manner, for example, the same patient may exhibit a different range of co-morbidities or drug sensitivities over a number of years.

Table 4 The most frequent patient co-morbidity clustering profiles: prescribed drugs—ATC therapeutic class*

Drug†	Natural opium alkaloids	Benzodiazepine derivatives	HMG CoA reductase inhibitors	Anilides	Penicillins with extended spectrum	Proton pump inhibitors	Cephalosporins and related substances	Coxibs	ACE inhibitors plain	Corticosteroids potent (group III)	Per 1000 patients
2											9.9
2											9.8
2											5.8
2											5.4
2											4.6
2											4.5
2											4.2
2											3.9
2											3.8
3											2.1
3											2.0
3											1.9
3											1.9
3											1.8
4											1.0
4											0.9
4											0.8
4											0.8
4											0.8
4											0.8
4											0.7
4											0.7
4											0.6
4											0.6
4											0.6
4											0.6
4											0.6
4											0.5
4											0.5
4											0.5
4											0.5
4											0.5
5											0.8
5											0.8
5											0.4
5											0.4
5											0.4
5											0.4
6											0.4
6											0.3
6											0.2
Per 1000 patients	14.5	21.5	20.6	13.2	43.9	17.2	40.9	15.1	14.5	25.7	

*Prescribed drugs contributing to each co-prescribing profile cluster are marked with “.”. Concurrent prescribed ATC classes marked with “.” may not be at the same ATC level. †Co-morbidity prescribing profiles based on prescribed ATC class have been reproduced in decreasing order of frequency until a cluster containing each of the top 10 that have frequencies above 0 have been identified.

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