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Health Studies Using Administrative Hospital Data

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Abstract

Traditionally administrative hospital discharge databases have been mainly used for administrative purposes. Recently, health services researchers and population health researchers have been using the databases for a wide variety of studies; in particular health care outcomes. Tools, such as comorbidity indexes, have been developed to facilitate this analysis. Every time the coding system for diagnoses and procedures is revised or a new one is developed, these comorbidity indexes need to be updated. These updates are important in maintaining consistency when trends are examined over time.

KEY WORDS: ICD-10-CA, Charlson, Elixhauser, Comorbidity Index, Administrative Database

1. Introduction

The use of health administrative data for health research in Canada has been facilitated by their availability, their wide geographic coverage and their relatively complete capture of contacts with the health system for a defined population. However, definitions have to be unified in order to allow comparison between provinces and years. A key methodological tool is the International Classification of Diseases (ICD) by the World Health Organization (WHO) which gives a standardized format to code diagnoses, thereby enabling longitudinal and comparative studies. Since 1975 International Classification of Disease, 9th Revision, (ICD-9) and the Clinical Modification (ICD-9-CM) have been used in Canada for coding hospital discharge records. In 1992, the 10th Revision of ICD (ICD-10) was introduced and beginning in 2001, the Canadian provinces started to phase in a Canadian version (the International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Canada (ICD-10-CA)) for coding hospital diagnoses. However, its implementation means that a number of established methodological tools applicable to the ninth revision, in particular the Charlson index and the Elixhauser comorbidities which give estimations of disease severity, needed to be redesigned for application in ICD-10-CA. Our study has looked at rates for the above co-morbidities by province before and after the change over and by looking at different combinations of corrections suggests the most consistent way to identify the rates with new coding algorithms.

2. Methods

ICD-10 was not simply an update of ICD-9 but a redesign, so simple mapping was not an option. Hude Quan and a group of researchers from the University of Calgary developed a version of the Charlson and the Elixhauser for ICD-10 from ICD-9-CM. They used two consecutive years of hospital discharge data from the Calgary Health Region: one in ICD-9-CM and the other in ICD-10.

For the Health Person Oriented Information database (HPOI), the database of all hospital discharge records in Canada at Statistics Canada, the need was for a version of the comorbidity indicators going from ICD-9 to ICD-10-CA. The Calgary group's resulting coding algorithms were used as a starting point. First the coding algorithms were corrected for the differences in definitions for each diagnosis between ICD-9 and ICD-9-CM and between ICD-10 and ICD-10-CA. Provinces that changed to ICD-10-CA in fiscal year 2001 were grouped together and provinces that still had not changed by fiscal year 2002 were grouped together. The corrected coding algorithm was then applied to the first 16 diagnoses of the hospital discharge records for the two groups from fiscal year 1998 to 2002. For each group the percent of hospitalizations with each comorbidity was plotted over time. If there was a sudden jump or fall for a comorbidity after the change to ICD-10-CA, the definitions and coding protocols for each code were reexamined.

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
3. Comorbidity Indicators

When administrative databases are used comorbidity indicators are an invaluable tool. They are used to assess a patient's disease burden from their diagnoses. These comorbidities are associated with increases in length of stay and mortality. Two of the most commonly used are the Charlson Index and the Elixhauser. The Charlson Index consists of 17 comorbidities. Each comorbidity is given a weighted score which can be summed to give an indicator of disease burden. The Elixhauser defines 31 comorbidities which can be used additively as an index or can be used separately as binary indicators. Both comorbidity measurement tools were developed with ICD-9-CM. So with the introduction of ICD-10-CA in Canadian hospital data, these comorbidity measurement tools needed to be updated.

4. Coding Systems in Canada

Canadian provinces and territories have switched from ICD-9 to ICD-10-CA over a number of years. The first provinces began to switch to ICD-10-CA in fiscal year 2001 and Quebec, the final province, just switch at the beginning of the current fiscal year. This leaves a patchwork of coding systems, which can cause much frustration when doing longitudinal or historical studies. Prior to the implementation of ICD-10-CA, provinces either used ICD-9 or ICD-9-CM. ICD-9-CM is the clinical modifications of ICD-9. At Statistics Canada all ICD-9-CM codes have been converted to ICD-9, so comparison between provinces is possible.

The Coding Classes of Provinces and Territories

-  ICD-10-CA/CCI
-  ICD-9/CCP
-  ICD-9-CM/ICD-9-CM procedures
-  Shaded areas indicate that no data was submitted for that fiscal year

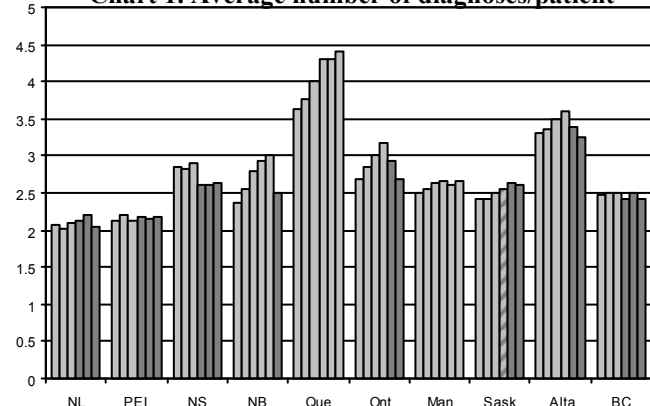
All diagnoses prior to fiscal 2001 were in ICD-9 (some provinces submitted ICD-9-CM but they were converted to ICD-9)

Province	Fiscal 2000	Fiscal 2001	Fiscal 2002	Fiscal 2003	Fiscal 2004	Fiscal 2005	Fiscal 2006
Newfoundland-Labrador	ICD-9/CCP	ICD-10-CA/CCI	ICD-10-CA/CCI	ICD-10-CA/CCI	ICD-10-CA/CCI	ICD-10-CA/CCI	ICD-10-CA/CCI
Prince Edward Island	ICD-9/CCP	ICD-10-CA/CCI	ICD-10-CA/CCI	ICD-10-CA/CCI	ICD-10-CA/CCI	ICD-10-CA/CCI	ICD-10-CA/CCI
Nova Scotia	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP
New Brunswick	ICD-9/CCP	ICD-9-CM/ICD-9-CM procedures	ICD-9-CM/ICD-9-CM procedures	ICD-9-CM/ICD-9-CM procedures	ICD-9-CM/ICD-9-CM procedures	ICD-9-CM/ICD-9-CM procedures	ICD-9-CM/ICD-9-CM procedures
Quebec*	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP
Ontario	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP
Manitoba*	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP
Saskatchewan	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP
Alberta	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP
British Columbia	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP
Yukon	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP
Northwest Territories	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP
Nunavut	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP	ICD-9/CCP

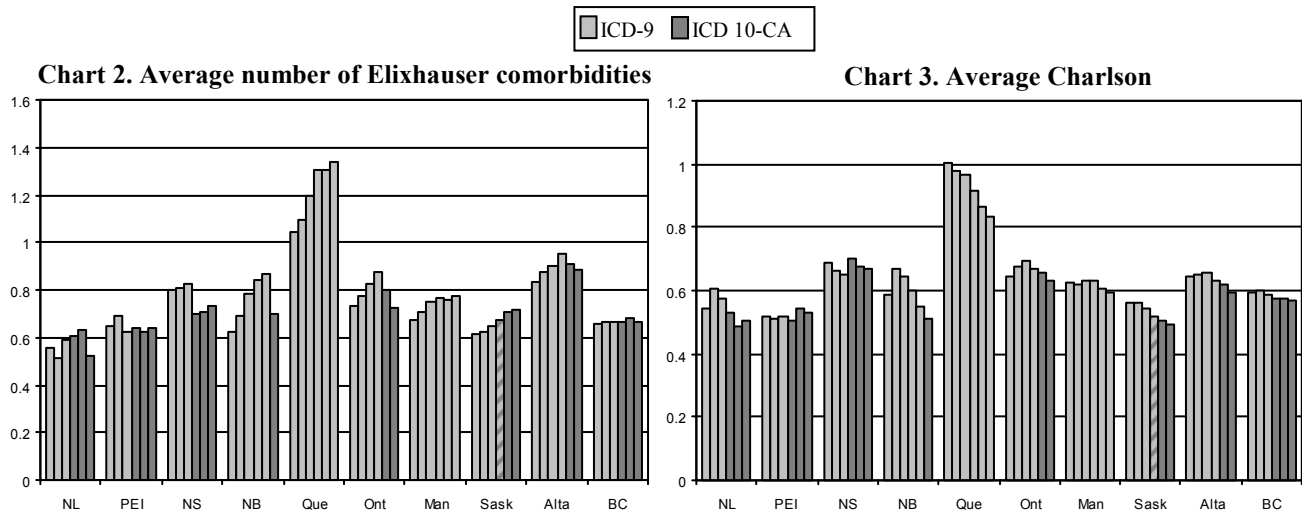
5. Comparison across years and provinces

The charts present data from fiscal years 1998 to 2003. As can be seen from Chart 1, the average number of diagnoses/patient varies greatly from province to province. Quebec reports the highest average number of diagnosis while Newfoundland and Prince Edward Island have the lowest. The variation in the average number of diagnoses may relate to the importance placed on charting the diagnoses at the hospital. Each province has different rules and regulations regarding these codes. Some areas do not have the resources to code all the diagnoses while others receive payment based on these records. Also some provinces had more extensive training for their coders when they switched

Chart 1. Average number of diagnoses/patient



to ICD-10-CA. Chart 2 gives the average number of Elixhauser comorbidities/patient by year and province. The trends follow those in Chart 1. Chart 3 shows the average Charlson Index/patient. The trends here are much smoother.



6. Conclusion

When some provinces have switched from ICD-9 to ICD-10-CA, there is a tendency to report less comorbidities (Chart 1). This is reflected in trend patterns found in the average number of Elixhauser comorbidities (Chart 2). The trends for the average Charlson Index are quite consistent between the two coding systems. This could be a reflection of the fact the more severe comorbidities are weighted more heavily and more likely to be coded. When doing a trend analysis which straddles the two coding systems, the Charlson Index is an appropriate tool. However, the average number of comorbidities is not appropriate for trend analysis as they can be affected by changing coding practices within a province.

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Appendix A Charlson Comorbidity Index Codes

Comorbidities	Score	ICD-9	ICD-10-CA
Myocardial infarction	1	410.x, 412.x	I21.x, I22.x, I25.2
Congestive heart failure	1	425.4-425.9, 428.x	I09.9, I11.0, I13.0, I13.2, I25.5, I42.0, I42.5-I42.9, I43.x, I50.x, P29.0
Peripheral vascular disease	1	093.0, 437.3, 440.x, 441.x, 443.1-443.9, 447.1, 557.1, 557.9, V43.4,	I67.1, I70.x, I71.x, I73.1, I73.8, I73.9, I77.1, I79.0, I79.2, K55.1, K55.8, K55.9, Z95.8, Z95.9
Cerebrovascular disease	1	430.x-438.x	G45.x G46.x, H34.0, I60.x-I69.x
Dementia	1	290.x, 294.1, 331.2	F00.x-F03.X, F05.1, G30.x, G31.1
Chronic pulmonary disease	1	416.8, 416.9, 490.x -505.x, 506.4, 508.1, 508.8	I27.8, I27.9, J40.x-J47.x, J60.x-J67.x, J68.4, J70.1, J70.3
Rheumatologic disease	1	446.5, 710.0-710.4, 714.0 -714.2, 714.8, 725.x,	M05.x, M06.x, M31.5, M32.x-M34.x, M35.1 M35.3, M36.0
Peptic ulcer disease	1	531.x-534.x	K25.x-K28.x
Mild liver disease	1	070.6, 070.9, 570.x, 571.x, 573.3, 573.4, 573.8, 573.9, V42.7	B18.x, K70.0-K70.3, K70.9, K71.3-K71.5, K71.7, K73.x, K74.x, K76.0, K76.2-K76.4, K76.8, K76.9, Z94.4
Diabetes without chronic complication	1	250.0-250.2, 250.7, 250.9	E10.1, E10.6, E10.9, E11.0, E11.1, E11.6, E11.8, E11.9, E13.0, E13.1, E13.6, E13.8, E13.9, E14.0, E14.1, E14.6, E14.9
Diabetes with chronic complication	2	250.3-250.6	E10.2- E10.5, E10.7, E11.2- E11.5, E11.7, E13.2- E13.5, E13.7, E14.2 - E14.5, E14.7
Hemiplegia or paraplegia	2	334.1, 342.x, 343.x, 344.0-344.6, 344.9	G04.1, G11.4, G80.x, G81.x, G82.x, G83.0-G83.4, G83.9
Renal disease	2	403.0, 403.1, 403.9, 404.9, 582.x, 583.0-583.7, 585.x, 586.x, 588.0, V42.0, V45.1, V56.x	I12.0, I13.1, N03.2-N03.7, N05.2-N05.7, N18.x, N19.x, N25.0, Z49.0-Z49.2, Z94.0, Z99.2
Any malignancy, including leukemia and lymphoma	2	140.x-172.x, 174.x-195.8, 200.x-208.x, 238.6	C00.x-C26.x, C30.x-C34.x, C37.x-C41.x, C43.x, C45.x-C58.x, C60.x-C76.x, C81.x-C85.x, C88.x, C90.x-C97.x
Metastatic solid tumor	3	196.x-199.x	C77.x-C80.x
Moderate or severe liver disease	3	456.0-456.2, 572.2-572.8,	I85.0, I85.9, I86.4, I98.2, K70.4, K71.1, K72.1, K72.9, K76.5, K76.6, K76.7
AIDS/HIV	6	042.x-044.x	B24.x

Appendix B Elixhauser Comorbidity Index Codes

Comorbidities	ICD-9	ICD-10-CA
Congestive heart failure	425.4-425.9, 428.x	I09.9, I11.0, I13.0, I13.2, I25.5, I42.0, I42.5-I42.9, I43.x, I50.x, P29.0
Cardiac arrhythmias	426.0, 426.7, 426.9, 427.0-427.4, 427.6-427.9, 785.0, V45.0, V53.3	I44.1-I44.3, I45.6, I45.9, I47.x-I49.x, R00.0, R00.1, R00.8, T82.1, Z45.0, Z95.0
Valvular disease	093.2, 394.x-397.x, 424.x, 746.3-746.6, V42.2, V43.3	A52.0, I05.x-I08.x, I09.1, I09.8, I34.x-I39.x, Q23.0-Q23.3, Z95.2-Z95.4
Pulmonary circulation disorders	415.0, 415.1, 416.x, 417.0, 417.8, 417.9	I26.x, I27.x, I28.0, I28.8, I28.9
Peripheral vascular disorders	093.0, 437.3, 440.x, 441.x, 443.1-443.9, 447.1, 557.1, 557.9, V43.4	I70.x, I71.x, I73.1, I73.8, I73.9, I77.1, I79.0, I79.2, K55.1, K55.8, K55.9, Z95.8, Z95.9
Hypertension, uncomplicated	401.x	I10.x
Hypertension, complicated	402.x-405.x	I11.x-I13.x, I15.x
Paralysis	334.1, 342.x, 343.x, 344.0-344.6, 344.9	G04.1, G11.4, G80.x, G81.x, G82.x, G83.0-G83.4, G83.9
Other neurological disorders	331.9, 332.0, 332.1, 333.4, 333.5, 334.x-335.x, 336.2, 340.x, 341.x, 345.x, 348.1, 348.3, 780.3, 784.3	G10.x-G13.x, G20.x-G22.x, G25.4, G25.5, G31.2, G31.8, G31.9, G32.x, G35.x-G37.x, G40.x, G41.x, G93.1, G93.4, R47.0, R56.x
Chronic pulmonary disease	416.8, 416.9, 490.x-505.x, 506.4, 508.1, 508.8	I27.8, I27.9, J40.x-J47.x, J60.x-J67.x, J68.4, J70.1, J70.3
Diabetes, uncomplicated	250.0-250.2	E10.0, E10.1, E10.9, E11.0, E11.1, E11.9, E12.0, E12.1, E12.9, E13.0, E13.1, E13.9, E14.0, E14.1, E14.9
Diabetes, complicated	250.3-250.9	E10.2-E10.8, E11.2-E11.8, E12.2-E12.8, E13.2-E13.8, E14.2-E14.8
Hypothyroidism	240.9, 243.x, 244.x, 246.1, 246.8	E00.x-E03.x, E89.0
Renal failure	403.1, 403.9, 404.9, 585.x, 586.x, 588.0, V42.0, V45.1, V56.x	I12.0, I13.1, N18.x, N19.x, N25.0, Z49.0-Z49.2, Z94.0, Z99.2
Liver disease	070.6, 070.9, 456.0-456.2, 570.x, 571.x, 572.2-572.8, 573.3, 573.4, 573.8, 573.9, V42.7	B18.x, I85.x, I86.4, I98.2, K70.x, K71.1, K71.3-K71.5, K71.7, K72.x-K74.x, K76.0, K76.2-K76.9, Z94.4
Peptic ulcer disease excluding bleeding	531.7, 531.9, 532.7, 532.9, 533.7, 533.9, 534.7, 534.9	K25.7, K25.9, K26.7, K26.9, K27.7, K27.9, K28.7, K28.9
AIDS/HIV	042.x-044.x	B24.x
Lymphoma	200.x-202.x, 203.0, 238.6	C81.x-C85.x, C88.x, C96.x, C90.0, C90.2
Metastatic cancer	196.x-199.x	C77.x-C80.x
Solid tumor without metastasis	140.x-172.x, 174.x-195.x	C00.x-C26.x, C30.x-C34.x, C37.x-C41.x, C43.x, C45.x-C58.x, C60.x-C76.x, C97.x
Rheumatoid arthritis/collagen vascular diseases	446.x, 701.0, 710.x, 711.2, 714.x, 719.3, 720.x, 725.x, 728.5	L94.0, L94.1, L94.3, M05.x, M06.x, M08.x, M12.0, M12.3, M30.x, M31.0-M31.3, M32.x-M35.x, M45.x, M46.1, M46.8, M46.9
Coagulopathy	286.x, 287.1, 287.3-287.5	D65-D68.x, D69.1, D69.3-D69.6
Obesity	278.0	E66.x
Weight loss	260.x-263.x, 783.2, 799.4	E40.x-E46.x, R63.4, R64
Fluid and electrolyte disorders	253.6, 276.x	E22.2, E86.x, E87.x
Blood loss anemia	280.x, 281.x	D50.x-D53.x
Deficiency anemia		
Alcohol abuse	265.2, 291.1-291.3, 291.5-291.9, 303, 305.0, 357.5, 425.5, 535.3, 571.0-571.3, 980.x	F10, E52, G62.1, I42.6, K29.2, K70.0, K70.3, K70.9, T51.x, Z50.2, Z71.4, Z72.1
Drug abuse	292.x, 304.x, 305.2-305.9	F11.x-F16.x, F18.x, F19.x, Z71.5, Z72.2
Psychoses	293.8, 295.x, 297.x, 298.x	F20.x, F22.x-F25.x, F28.x, F29.x, F30.2, F31.2, F31.5
Depression	296.1, 296.3, 300.4, 309.x, 311	F20.4, F31.3-F31.5, F32.x, F33.x, F34.1, F41.2, F43.2