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Manitoba Centre for Health Policy
Faculty of Health Sciences
College of Medicine, University of Manitoba
4th Floor, Room 408
727 McDermot Avenue
Winnipeg, Manitoba, Canada
R3E 3P5

Email: reports@cpe.umanitoba.ca

Phone: (204) 789-3819

Fax: (204) 789-3910

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EXECUTIVE SUMMARY

Background

This study examined Manitoba Cancer Registry data for the period from 1984 to 2011. These data were recently acquired into the Population Health Research Data Repository (Repository) housed at the Manitoba Centre for Health Policy (MCHP). The Manitoba Cancer Registry data contain information about all incident cases of diagnosed cancer, including demographic variables (e.g., age, sex, residential postal code), cancer treatments and dates of treatment, tumour characteristics, and cancer stage at diagnosis.

The Manitoba Cancer Registry, like other cancer registries across Canada and internationally, was originally intended to be used for surveillance and cancer control initiatives. Other studies have linked Manitoba Cancer Registry data with a select number of administrative health data to conduct investigations about health and health service use in individuals with a cancer diagnosis. However, incorporating the Manitoba Cancer Registry data into the Repository housed at MCHP enables a broader range and scope of cancer-related investigations using linked administrative data, including those about the social determinants of health, comparative effectiveness of cancer treatments, and quality of care across the healthcare spectrum.

Objectives

The objectives were:

1. To apply data quality evaluation tools developed at MCHP to the Manitoba Cancer Registry data to assess fitness of these data for cancer-related research involving linked data in the Repository;
2. To investigate additional measures of data quality that are relevant to the linkage of cancer registry and administrative data in the Repository; and
3. To conduct demonstration projects that link Manitoba Cancer Registry data to other administrative health data, allowing for new research opportunities.

Two demonstration projects, one with a policy focus and one with a methodological focus, were selected by researchers from CancerCare Manitoba and MCHP. The demonstration projects improved the skills of research team members in working with the de-identified, linked data, and generated new information about the Manitoba Cancer Registry to add to the MCHP Concept Dictionary, an on-line research tool that provides detailed operational definitions of variables or measures used in MCHP research.

The majority of the research focuses on the four leading cancers: breast, lung, prostate, and colorectal. However, we also investigated less prevalent cancers that were of interest to research team members, including bladder cancer and Chronic Lymphocytic Leukemia.

Methods

The MCHP Data Quality Framework, which is routinely applied to all new data acquired into the Repository, was applied to the Manitoba Cancer Registry data. A standardized set of analyses was conducted to examine such elements of data quality as completeness of data fields, internal consistency, and linkability of patient-identification variables in the Manitoba Cancer Registry with the corresponding variables in other administrative health data. We also investigated two data quality measures that are not in the MCHP Data Quality Framework, but provided additional insights about data quality: (a) agreement of postal codes recorded in the Manitoba Cancer Registry with postal codes recorded in other administrative data sources, and (b) validity of cancer diagnosis codes in hospital

The Manitoba Cancer Registry data undergo systematic quality evaluations prior to their integration into the Canadian Cancer Registry and in order to achieve certification from the North American Association of Central Cancer Registries. Thus, the data have very high quality. Application of the MCHP Data Quality Framework to these data produced standardized data quality documentation. This standardized information is essential for making quality comparisons across different data in the Repository housed at MCHP; it ensures that all researchers who use the Repository have comparative information about the characteristics of all types of administrative data.

The demonstration projects revealed the importance of having access to documentation and expertise with the Manitoba Cancer Registry data. As well, these projects highlight the benefits of working in collaborative teams to define research problems, develop appropriate methodologies, and interpret the study results.

Recommendations

Based on these findings and conclusions, the following recommendations arise from this study:

1. Ensure that research teams using Manitoba Cancer Registry data have access to expertise from both CancerCare Manitoba and MCHP.
2. Develop concepts on cancer-related project-specific data quality for the MCHP Concept Dictionary.
3. Incorporate additional CancerCare Manitoba data to strengthen cancer-related population health and health services research in Manitoba.
4. Undertake new MCHP deliverables and research projects that capitalize on the strengths of the Manitoba Cancer Registry data and the rich and diverse data resources available in the Repository.

CHAPTER 2: APPLYING MCHP'S DATA QUALITY FRAMEWORK TO THE MANITOBA CANCER REGISTRY

Introduction

An assessment of data quality is an essential component of any study involving secondary data. The MCHP Data Quality Framework was developed in 2012 after a thorough review of existing secondary data quality frameworks from such organizations as the Canadian Institute for Health Information, Statistics Canada, and Australian Bureau of Statistics. The MCHP Framework provides a standardized and routinized approach to evaluate the quality of administrative data in the Repository (Lix et al., 2012c). The Framework has two components: (a) data-specific quality, and (b) project-specific quality. The former focuses on data quality measures that can be produced with minimal linkages amongst the administrative data. The latter focuses on data quality measures that are investigated within a research project and require linkage of the de-identified data in the Repository. Data quality measures in the Framework have been operationalized via SAS macros (standardized statistical program code¹). For example, the VIMO macro produces information about the percentage of valid, invalid, missing, and outlying observations for each field in a dataset, while the TREND macro produces a fitted line or curve to a temporal data series to identify potential outliers. These macros are useful for exploring data quality at a high level, and for initiating conversations about potential challenges in the analysis and interpretation of the data.

Quality of Cancer Registry Data

Several dimensions of data quality in the MCHP Data Quality Framework are consistent with the dimensions identified as key elements of cancer registry data quality (see Figure 2.1). For example, Parkin and Bray identified the following key elements of cancer registry data quality: comparability, validity, completeness, and timeliness (Bray & Parkin, 2009; Parkin & Bray, 2009). Comparability refers to the extent to which cancer registry practices adhere to standard guidelines, enabling fair comparisons of the number of cancer cases across time and space. If data comparability cannot be achieved, then variations in the number of cancer cases may be a function of differences in data collection/capture methods, rather than a true reflection of the underlying health of a population. Validity is defined as the extent to which a cancer case possesses the attributes in individual cancer registry fields (e.g., type of cancer). Completeness reflects the degree to which all cancer cases are captured within a registry. Methods to ensure completeness of cancer registries include the use of multiple data sources to ascertain cases and legislation to ensure mandatory case reporting. For example, completeness can be evaluated by linking cancer registry data with other sources, such as clinical registries, to identify potentially missed cases. Dataset audits and chart abstractions can also be used to estimate completeness. Finally, timeliness is the degree to which data are up-to-date and contain complete and accurate information. Sometimes there is a tradeoff between timeliness and accuracy or completeness. Components of timeliness include the duration of time from diagnosis to receipt of a report of a cancer case by a registrar, and processing time, defined as the time from receipt of the report of a cancer case to data availability.

1 Descriptions and technical details of all macros used in the MCHP Data Quality Framework are available on the MCHP website http://umanitoba.ca/faculties/health_sciences/medicine/units/community_health_sciences/departamental_units/mchp/resources/repository/dataquality.html

Comparisons between Cancer Cohort and Matched Cancer-Free Cohort

A total of 125 cancer patients could not be matched to a cancer-free cohort member and are therefore excluded from the analysis. The cancer cohort and matched cancer-free cohort are described on the continuous comorbidity measures in Table 4.2; included are the number of ADGs®, Chronic Disease Score, number of different diagnoses, number of different prescription drugs, RUBs, and the Charlson index.

As expected, individuals in the cancer cohort had a higher level of comorbidity than individuals in the cancer-free cohort on most measures and across all cancer sites. Differences between the two groups were largest for lung and prostate cancers.

Table 4.2: Descriptive Statistics (Mean and Standard Deviation) of Comorbidity Measures for Cancer Cohort and Matched Cancer-Free Cohort

By cancer site, 1997/98–2011/13

Comorbidity Measures	Cancer Cohort	Matched Cancer-Free Cohort	Standardized Difference
Bladder			
No. of Diagnoses	5.79 (4.59)	4.38 (4.37)	0.31
No. of Drugs	7.43 (4.76)	4.77 (4.57)	0.55
No. of Aggregated Diagnosis Groups™	5.72 (2.80)	3.65 (2.92)	0.68
Resource Utilization Bands	3.47 (0.82)	2.65 (1.30)	0.70
Chronic Disease Score	2.51 (2.23)	2.21 (2.21)	0.14
Charlson Index	1.66 (1.66)	0.67 (1.20)	0.64
Breast			
No. of Diagnoses	4.37 (3.93)	4.31 (4.17)	0.01
No. of Drugs	5.55 (3.88)	4.61 (4.18)	0.23
No. of Aggregated Diagnosis Groups™	4.47 (2.57)	3.62 (2.80)	0.31
Resource Utilization Bands	3.06 (0.78)	2.57 (1.16)	0.48
Chronic Disease Score	2.04 (1.99)	2.02 (2.09)	0.01
Charlson Index	0.98 (1.36)	0.45 (0.87)	0.45
Chronic Lymphocytic Leukemia			
No. of Diagnoses	4.86 (4.03)	4.35 (4.13)	0.13
No. of Drugs	5.87 (3.95)	4.66 (4.27)	0.29
No. of Aggregated Diagnosis Groups™	4.61 (2.60)	3.65 (2.88)	0.35
Resource Utilization Bands	3.16 (0.88)	2.64 (1.21)	0.48
Chronic Disease Score	2.34 (2.04)	2.14 (2.09)	0.10
Charlson Index	1.26 (1.32)	0.63 (1.22)	0.48
Colorectal			
No. of Diagnoses	4.97 (4.19)	4.44 (4.15)	0.13
No. of Drugs	7.24 (4.53)	4.64 (4.28)	0.57
No. of Aggregated Diagnosis Groups™	5.44 (2.72)	3.60 (2.80)	0.63
Resource Utilization Bands	3.37 (0.84)	2.63 (1.21)	0.67
Chronic Disease Score	2.39 (2.10)	2.20 (2.09)	0.09
Charlson Index	1.55 (1.80)	0.60 (1.05)	0.61
Lung			
No. of Diagnoses	6.40 (4.67)	4.58 (4.21)	0.40
No. of Drugs	7.91 (4.66)	4.72 (4.19)	0.68
No. of Aggregated Diagnosis Groups™	6.02 (2.78)	3.68 (2.78)	0.78
Resource Utilization Bands	3.70 (0.95)	2.64 (1.18)	0.89
Chronic Disease Score	3.12 (2.30)	2.27 (2.12)	0.38
Charlson Index	2.43 (2.10)	0.58 (1.01)	0.98
Prostate			
No. of Diagnoses	4.91 (3.67)	4.16 (4.08)	0.19
No. of Drugs	5.97 (3.81)	4.39 (4.21)	0.39
No. of Aggregated Diagnosis Groups™	4.62 (2.46)	3.42 (2.75)	0.45
Resource Utilization Bands	3.24 (0.74)	2.59 (1.27)	0.59
Chronic Disease Score	2.14 (1.90)	2.10 (2.06)	0.02
Charlson Index	1.23 (1.44)	0.63 (1.09)	0.46

Bold values indicate a significant difference between cancer cohort and matched cancer-free cohort at $\alpha=0.05$

In Table 4.5, the percentage of the cancer cohort and matched cancer-free cohort in each of the RUB categories are shown by cancer site. A substantially higher percentage of the cancer cohort was in the “high morbidity” and “very high morbidity” categories when compared to the matched cancer-free cohort. The highest percentage of cancer patients in the very high morbidity category was for lung (23.0%) and bladder (13.9%), and the lowest was for breast (4.9%) and CLL (6.7%).

The cumulative mean number of new diagnoses in hospital discharge abstracts and physician billing claims and of new prescription drugs was measured over the period from 23 months prior to a cancer diagnosis to 12 months post-cancer diagnosis; the results are shown in Figures 4.1 and 4.2, respectively. All cancer sites demonstrated an increase in both the number of diagnoses and prescription drugs over this observation period. The rate of increase in the pre-diagnosis period was similar for all cancer sites. However, in the post-diagnosis period there was a larger rate of increase in the mean number of new diagnoses amongst lung, bladder, and colorectal cancer patients; for new prescription drug dispensations, the rate of increase in the mean number in the post-diagnosis period was much higher for lung cancer patients than it was for other cancer patients. See Appendix 5 for figures that show the cumulative mean number of new diagnoses and new prescription drug dispensations that include cancer-related diagnoses and drugs.

Table 4.10: Measures of Explained Variation and Error for Negative Binomial Models Predicting Ambulatory Physician Visit Rates

By cancer site, 1997/98-2011/12

Models	R ²	ΔR ² (%)	RMSE	Abs ΔRMSE (%)
Bladder				
Base	0.413	--	6.79	--
No. of diagnoses	0.464	0.05 (12.49)	6.45	0.34 (5.04)
No. of drugs	0.464	0.05 (12.50)	6.44	0.35 (5.13)
No. of Aggregated Diagnosis Groups™	0.465	0.05 (12.66)	6.44	0.35 (5.22)
Resource Utilization Bands	0.438	0.03 (6.23)	6.61	0.18 (2.61)
Chronic Disease Score	0.462	0.05 (11.85)	6.46	0.33 (4.86)
Charlson Index	0.422	0.01 (2.31)	6.73	0.06 (0.90)
Elixhauser Index	0.463	0.05 (12.31)	6.45	0.34 (4.97)
Breast				
Base	0.239	--	7.85	--
No. of diagnoses	0.359	0.12 (49.78)	7.24	0.61 (7.77)
No. of drugs	0.347	0.11 (44.94)	7.29	0.56 (7.15)
No. of Aggregated Diagnosis Groups™	0.352	0.11 (47.05)	7.26	0.59 (7.54)
Resource Utilization Bands	0.285	0.05 (19.14)	7.63	0.22 (2.75)
Chronic Disease Score	0.324	0.08 (35.24)	7.42	0.43 (5.50)
Charlson Index	0.244	0.00 (1.89)	7.83	0.02 (0.25)
Elixhauser Index	0.318	0.08 (32.88)	7.45	0.39 (5.02)
Chronic Lymphocytic Leukemia				
Base	0.184	--	7.38	--
No. of diagnoses	0.380	0.20 (106.60)	6.50	0.89 (12.03)
No. of drugs	0.337	0.15 (83.43)	6.70	0.69 (9.28)
No. of Aggregated Diagnosis Groups™	0.358	0.17 (94.98)	6.53	0.85 (11.53)
Resource Utilization Bands	0.253	0.07 (37.55)	7.09	0.29 (3.93)
Chronic Disease Score	0.317	0.13 (72.39)	6.76	0.62 (8.40)
Charlson Index	0.219	0.04 (19.09)	7.21	0.17 (2.35)
Elixhauser Index	0.319	0.13 (73.26)	6.74	0.65 (8.76)
Colorectal				
Base	0.486	--	7.61	--
No. of diagnoses	0.517	0.03 (6.38)	7.39	0.23 (2.97)
No. of drugs	0.522	0.04 (7.27)	7.36	0.26 (3.37)
No. of Aggregated Diagnosis Groups™	0.517	0.03 (6.34)	7.38	0.23 (3.08)
Resource Utilization Bands	0.496	0.01 (2.02)	7.54	0.07 (0.92)
Chronic Disease Score	0.516	0.03 (6.18)	7.39	0.22 (2.90)
Charlson Index	0.489	0.00 (0.60)	7.59	0.02 (0.26)
Elixhauser Index	0.515	0.03 (5.95)	7.39	0.22 (2.95)
Lung				
Base	0.658	--	6.21	--
No. of diagnoses	0.679	0.02 (3.16)	5.94	0.27 (4.33)
No. of drugs	0.675	0.02 (2.58)	6.00	0.21 (3.37)
No. of Aggregated Diagnosis Groups™	0.678	0.02 (2.98)	5.97	0.24 (3.89)
Resource Utilization Bands	0.665	0.01 (0.99)	6.14	0.07 (1.14)
Chronic Disease Score	0.670	0.01 (1.84)	6.07	0.14 (2.33)
Charlson Index	0.659	0.00 (0.15)	6.20	0.01 (0.23)
Elixhauser Index	0.670	0.01 (1.78)	6.07	0.14 (2.29)
Prostate				
Base	0.149	--	6.54	--
No. of diagnoses	0.270	0.12 (81.53)	6.07	0.47 (7.18)
No. of drugs	0.254	0.10 (70.41)	6.12	0.42 (6.44)
No. of Aggregated Diagnosis Groups™	0.255	0.11 (71.36)	6.11	0.43 (6.58)
Resource Utilization Bands	0.190	0.04 (27.37)	6.39	0.15 (2.36)
Chronic Disease Score	0.236	0.09 (58.74)	6.20	0.34 (5.20)
Charlson Index	0.160	0.01 (7.68)	6.49	0.05 (0.72)
Elixhauser Index	0.229	0.08 (53.73)	6.22	0.32 (4.86)

Bold values indicate a statistically significant difference from the base model at α=0.05

RMSE indicates Root-Mean-Square Error

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Appendix Table: Continued

Presenting Complaint Group	ADT/E-Triage Complaint Code	EDIS Complaint Category	EDIS Chief Complaint
Trauma	Abdominal Complaint (Trauma) Altered LOC (Trauma) Back Complaint (Trauma) Burns and Scalds Chest Complaint (Trauma) Eye Complaint (Trauma) Ear Complaint (Trauma) Head Injury Lacerations/Abrasions/ Contusions Limb Complaint (Trauma) Major Trauma Minor Trauma Nasal Complaint (Trauma) Near Drowning/Barotrauma Neck Complaint (Trauma) Pregnancy < 20 weeks (Trauma) Pregnancy > 20 weeks (Trauma)	Laceration/Puncture Lower Extremity Injury Trauma Upper Extremity Injury	Abdominal Complaint (Trauma) Altered LOC (Trauma) Back Complaint (Trauma) Burns and Scalds Chest Complaint (Trauma) Eye Complaint (Trauma) Ear Complaint (Trauma) Head Injury Lacerations/Abrasions/ Contusions Limb Complaint (Trauma) Major Trauma Minor Trauma Nasal Complaint (Trauma) Near Drowning/ Barotrauma Neck Complaint (Trauma) Pregnancy < 20 weeks (Trauma) Pregnancy > 20 weeks (Trauma)
Haematology	Blood Disorder Complaint	n/a	Blood Disorders Complaint
Endocrinology	Diabetic Complaint	n/a	Diabetic Complaint
Psychiatric	Mental Health Assessment Social Concerns	Mental Health	Mental Health Assessment Social Concerns
Substance Abuse	Substance Complaint Toxic Ingestion/ Poisoning/Overdose	Substance Misuse	Overdose (Ingestion) Substance Abuse Toxic Ingestion/ Poisoning/Overdose

Appendix Table 2.2: Valid, Invalid, Missing, and Outlier (VIMO) Table for Manitoba Cancer Registry Data, 1984-2011

Total number of records: 218,786

Type	Variable Name	Variable Description	Valid (%)	Invalid (%)	Missing (%)	Outlier (%)	Potential Data Quality Issues ¹	Minimum	Maximum	Mean	Median	Standard Deviation	Footnotes	
ID	FILEPHIN	MHHLS scrambled PHIN	100		0		None or Minimal (<5%)							
	TUMOURID	Tumour ID number	100		0		None or Minimal (<5%)							
	ACQDT	Date first acquired at MCHP	100		0		None or Minimal (<5%)	2014-02-25	2014-02-25				2	
	BIRTHDT	Birth date (SAS)	100		0		None or Minimal (<5%)	1881-07-27	2011-12-03				3	
Date	DXDT	Diagnosis date (SAS)	100		0		None or Minimal (<5%)	1984-01-01	2011-12-31				3	
	DXAGE	Age at diagnosis	99.77		0.0	0.23	None or Minimal (<5%)	0	109.00	65.74	68.35	16.18		
Num	AJCC6	AJCC summary stage 6th edition (2004 or later)	24.83		75.17		Significant (>30%)	IV, I, NA, II, 0, IA, IIB, UNK, IA, IB						4
	AJCC7	AJCC summary stage 7th edition (2010 or later)	6.66		93.34		Significant (>30%)	IV, 0, IA, IIA, NA, I, IIB, IIB, IIA, IB						4
	BIRDTST	Birth date status	100		0.0		None or Minimal (<5%)	C, D, M						3,4
	CANCER_SITE	Cancer site	100		0.0		None or Minimal (<5%)	Other skin and in situ, breast, lung and bronchus, prostate, colon excluding rectum, cervix uteri, rectum and rectosigmoid, other, ill defined & unknown, bladder, non-Hodgkin lymphoma						4
DX_CONFIRM	DX_CONFIRM	Diagnostic confirmation (2004 or later)	32.90		67.10		Significant (>30%)	histology, radiology, cytology, histology plus positive, laboratory test, death certificate, surgical, clinical, autopsy, unknown						4
	DXDATEST	Status of date of diagnosis	100		0.0		None or Minimal (<5%)	C, D, M						3,4
	DXMETHOD	Diagnosis method	100		0.0		None or Minimal (<5%)	histology, cytology, radiology/laboratory test, radiology, surgical/clinical, death certificate, laboratory test, autopsy, clinical, surgical						4
	DXPC	Postal code at diagnosis	100		0.0		None or Minimal (<5%)	ROJ1H0, ROL1Z0, ROA2A0, ROM2C0, ROE0C0, ROJ1E0, ROG0J0, ROC2Z0, ROC1B0, ROK1G0, ROG0B0, ROE1A0, ROL1P0, ROK2C0, ROK0E0, ROE0K0, ROK0H0, R0C0A0, ROM0M0, ROLOY0, and others						4,5
Characters	FILEPHINTYPE	MCHP method to determine FILEPHIN	100		0.0		None or Minimal (<5%)	0					2,4	
	GENDER	Gender	100		0.0		None or Minimal (<5%)	F, M					4	
	LATERAL	Laterality of tumour	51.05		48.95		Significant (>30%)	right, left, unknown, bilateral, midline, unilateral					4	
	M6	Metastasis stage according to AJCC 6th edition	24.83		75.17		Significant (>30%)	M0, NA, M1, M2, M1b, M1c, M1a, MINOS					4	
	M7	Metastasis stage according to AJCC 7th edition	6.66		93.34		Significant (>30%)	M0, NA, M1b, M1, M1a, M1c					4	
	MALIGNUM	Malignant number or primary number	100		0.0		None or Minimal (<5%)	1, 2, 3, 4, 5, 6, 7, 8					4	
	MORPH3	ICD-O3 histology	100		0.0		None or Minimal (<5%)	81403, 80903, 80703, 85003, 80103, 80003, 80702, 80973, 80102, 81303					3,4	
	N6	Node stage according to AJCC 6th edition	24.83		75.17		Significant (>30%)	N0, NA, N1, N2, NX, N1a, N3, N2a, N3a, N2b					4	
	N7	Node stage according to AJCC 7th edition	6.66		93.34		Significant (>30%)	N0, NA, N1, N2, N1a, NX, N2a, N1b, N3, N2b					4	
	SEX	Sex of patient (MCHP)	100		0.0		None or Minimal (<5%)	2, 1					4	
	T6	Tumour stage according to AJCC 6th edition	24.83		75.17		Significant (>30%)	NA, T2, T3, T1s, T4, T1, T1c, T1b, T1a					4	
	T7	Tumour stage according to AJCC 7th edition	6.66		93.34		Significant (>30%)	NA, T3, T1s, T2, T1c, T1a, T1, T2a, T1b, T1x					4	
	TOPOG	ICD-O3 topography (site)	100		0		None or Minimal (<5%)	c443, c619, c448, c341, c421, c539, c509, c445, c504, c446					3,4	

1 indicates percent of values that could pose a data quality problem (i.e., sum of missing, invalid, and outlier values)
 2 variable has no variance or all values are missing
 3 indicates that no invalid values found
 4 indicates top 10 observed values
 5 all postal codes listed have frequency above 20

indicates numbers used as identifiers for data linkage
 indicates numeric value
 MHHLS indicates Manitoba Health, Healthy Living and Seniors
 MCHP indicates variable is created at the Manitoba Centre for Health Policy
 SAS indicates variable is calculated as SAS days
 AJCC indicates the guideline published by the American Joint Committee on Cancer
 Note: data for variables M6, M7, N6, N7, T6, and T7 in 2004-2009 are based on AJCC 6th ed. and in 2010-2011 both on AJCC 6th and 7th ed.

Appendix Table 2.4: Percent of Cancer Stage Information by Cancer Site in the Manitoba Cancer Registry, 2010–2011

Variable	Description	Breast	Colorectal	Lung	Prostate	All Other Sites	Total
Tumour (T)							
TX	Primary tumour cannot be assessed	0.22	0.70	0.39	0.54	1.51	3.35
T0	No evidence of primary tumour	0.04	0.02	0.07	0.03	0.14	0.29
Tis	Carcinoma in situ	1.20	2.48	0.00	0.00	4.83	8.51
Ta	Non-invasive papillary carcinoma	0.00	0.00	0.00	0.00	1.45	1.45
T1, T2, T3, T4	Numbers correspond to the size of the primary tumour and its spread. Higher numbers indicated larger tumours and greater spread	8.78	8.30	8.44	6.87	17.93	50.32
NA	Not applicable	0.02	0.02	0.02	0.00	9.85	9.91
Missing	Missing data	0.00	0.00	0.00	0.00	26.17	26.17
Total	--	10.26	11.52	8.92	7.44	61.88	100
Lymph Nodes (N)							
NX	Regional lymph nodes cannot be assessed	0.19	0.39	0.16	0.26	0.71	1.70
N0	No evidence that regional lymph nodes are involved	7.02	7.60	4.16	6.65	21.31	46.74
N1, N2 or N3	The number corresponds to the degree of spread of cancer to the lymph nodes	3.03	3.50	4.58	0.53	3.85	15.48
NA	Not applicable	0.02	0.02	0.02	0.00	9.85	9.90
Missing	Missing data	0.00	0.00	0.00	0.00	26.17	26.17
Total	--	10.26	11.51	8.92	7.44	61.89	100
Metastasis (M)							
M0	No evidence of distant metastasis	9.66	9.77	4.37	6.70	22.73	53.24
M1	Distant metastasis is present	0.57	1.72	4.53	0.73	3.14	10.69
NA	Not applicable	0.02	0.02	0.02	0.00	9.85	9.90
Missing	Missing data	0.00	0.00	0.00	0.00	26.17	26.17
Total	--	10.25	11.51	8.92	7.43	61.89	100

Appendix Table 2.6: Valid, Invalid, Missing, and Outlier (VIMO) Table for Manitoba Cancer Treatment Data, 1984-2011

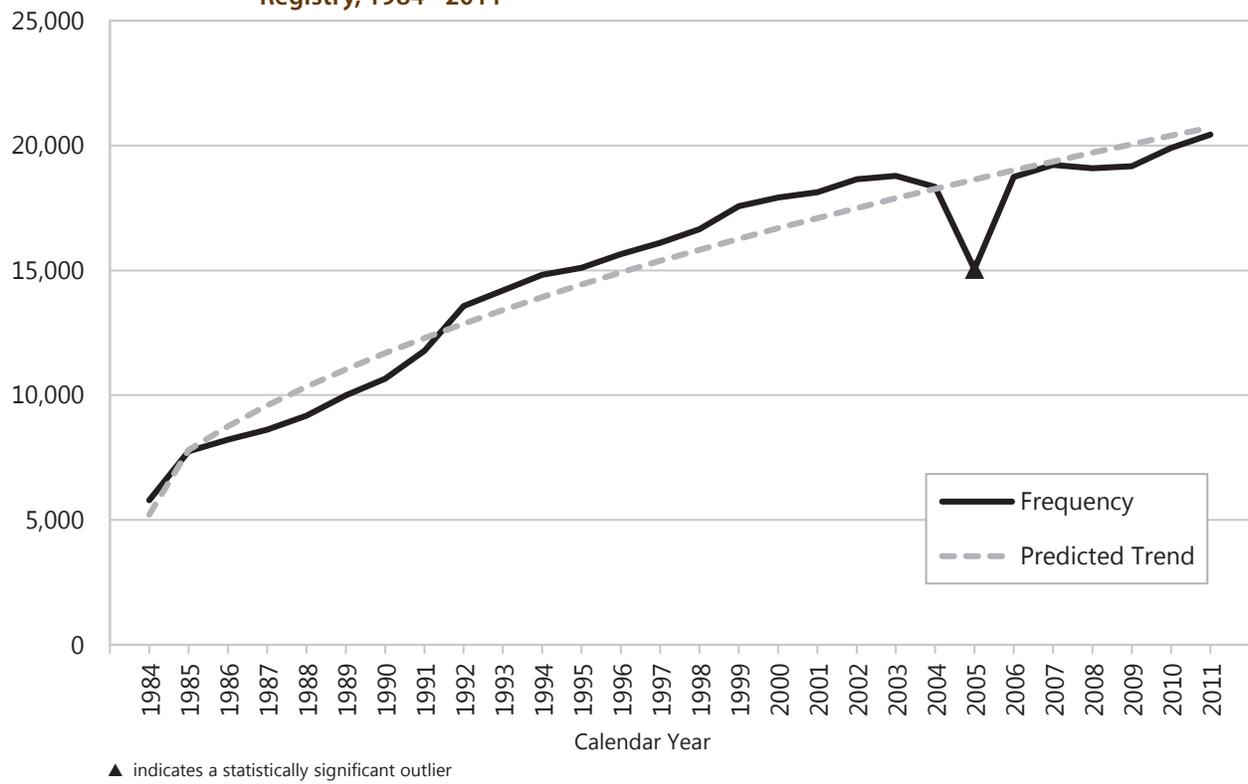
Total number of records: 432,530

Type	Variable Name	Variable Description	Valid (%)	Invalid (%)	Missing (%)	Outlier (%)	Potential Data Quality Issues ¹	Minimum	Maximum	Mean	Median	Standard Deviation	Footnotes
ID	FILEPHIN	MHLS Scrambled PHIN	100		0		None or Minimal (<5%)						
	TUMOURID	Tumour ID number	100		0		None or Minimal (<5%)						
	ACQDT	Date first acquired at MCHP	100		0		None or Minimal (<5%)	2014-02-25	2014-02-25				2
Date	TXDXT	Treatment Date	100	0	0		None or Minimal (<5%)	1900-01-01	2066-05-16				3
Characters	CCI	Canadian Classification of Health Interventions (2005 or later)	34		66		Significant (>30%)	1ZZ35HAM0, 1ZZ35CAM6, 1YF87LA, 1YS87LA, 1YD87LA, 1ZZ35CAM0, 1YT87LA, 1YB87LA, 1YM87LA, 1YMZ7A					
	FILEPHINTYPE	MCHP Method to determine FILEPHIN	100		0		None or Minimal (<5%)	0					2
	TXDATA TEST	Treatment Date Status	100		0		None or Minimal (<5%)	c, d, m, y					
	TXICD9	ICD-9 Procedure code (1984-2004)	66		34		Significant (>30%)	863, 9925, 9924, 9224, 9223, 2132, 8521, 5749, 8543, 403					

ID indicates numbers used as identifiers for data linkage
 Num indicates numeric value
 MHLS indicates Manitoba Health, Healthy Living and Seniors
 MCHP indicates variable is created at the Manitoba Centre for Health Policy

1 percent of values that could pose a data quality problem (i.e., sum of missing, invalid, and outlier values)
 2 variable has no variance or all values are missing
 3 variable has 2 invalid observations (2021-07-20, 2066-05-16)

Appendix Figure 2.4: Trend Analysis (Frequency) for Cancer Treatment Date in the Manitoba Cancer Registry, 1984 - 2011



Appendix Table 2.9: Frequency of Error Messages for Validation Checks on Data Consistency in the Manitoba Cancer Registry Data, 1984-2011

Error Message	Frequency
Patient received treatment at age 120 years and older	1
Treatment date start before patient's birth date	4*
Treatment date start before diagnosis date (based on complete diagnosis and treatment date)	398**
Treatment date start before diagnosis date (based on complete diagnosis and treatment date and patient's birth date is between Jan 1, 1984 and Dec 31, 2011)	3

* Not a problem, all 4 records have a treatment date of 1900-01-01, which represent missing year, month, day in Cancer Registry data

** Probably not a problem, Cancer Registry was extracted based on diagnosis date between Jan 1, 1984 and Dec 31, 2011, there could be a diagnosis date earlier than Jan 1, 1984

APPENDIX 3: POISSON REGRESSION MODEL RESULTS FOR EMERGENCY DEPARTMENT USE IN THE PRE-, PERI- AND POST-DIAGNOSIS PERIODS

Regression Models Results for Cancer Cohorts and Matched Cancer-Free Cohorts

Appendix Table 3.1: Poisson Regression Model Results for Emergency Department Use, Breast Cancer Cohort and Matched Cancer-Free Cohort
Winnipeg residents, 2007/08-2010/11

Model Covariates	Relative Rate (95% Confidence Interval)	p-value
Intercept	0.01 (0.01, 0.01)	< 0.0001
Month of Diagnosis	0.99 (0.98, 0.99)	0.0008
Cancer Cohort (ref = Matched Cancer-Free Cohort)	1.11 (0.93, 1.32)	0.2553
Time Period (ref = Pre-Diagnosis)		
Peri-Diagnosis Period	1.00 (0.76, 1.31)	0.9923
Post-Diagnosis Period	1.37 (1.11, 1.70)	0.0034
Interaction of Cohort and Time Period (ref = Matched Cancer-Free Cohort in Pre-Diagnosis Period)		
Cancer Cohort in Peri-Diagnosis Period	1.57 (1.15, 2.16)	0.0050
Cancer Cohort in Post-Diagnosis Period	1.31 (1.06, 1.61)	0.0108
Age	1.00 (1.00, 1.01)	0.1760
Sex (ref = Female)	1.07 (0.71, 1.61)	0.7359
Income Quintile (ref = Q5 (highest))		
Q1 (lowest)	1.58 (1.38, 1.82)	< 0.0001
Q2	1.48 (1.28, 1.72)	< 0.0001
Q3	1.40 (1.21, 1.62)	< 0.0001
Q4	1.21 (1.04, 1.40)	0.0138
Income Unknown	0.93 (0.75, 1.15)	0.4803
Charlson Index	1.27 (1.23, 1.32)	< 0.0001
Number of Inpatient Hospitalizations	4.25 (3.89, 4.64)	< 0.0001
Majority of Care	0.93 (0.85, 1.01)	0.0763
Number of Ambulatory Physician Visits	1.35 (1.32, 1.38)	< 0.0001
Number of Prescription Drug Dispensations	1.02 (1.02, 1.03)	< 0.0001
Comparison Tests	Relative Rate (95% Confidence Interval)	p-value
Cancer Cohort vs. Matched Cancer-Free Cohort		
Overall	1.41 (1.18, 1.68)	0.0001
Pre-Diagnosis Period	1.11 (0.82, 1.50)	0.5088
Peri-Diagnosis Period	1.74 (1.31, 2.32)	0.0001
Post-Diagnosis Period	1.45 (1.26, 1.67)	< 0.0001
Cancer Cohort: Comparison of Time Periods		
Peri-Diagnosis Period vs. Pre-Diagnosis Period	1.58 (1.16, 2.14)	0.0035
Post-Diagnosis Period vs. Pre-Diagnosis Period	1.79 (1.33, 2.43)	0.0002
Post-Diagnosis Period vs. Peri-Diagnosis Period	1.14 (0.93, 1.39)	0.2087
Matched Cancer-Free Cohort: Comparison of Time Periods		
Peri-Diagnosis Period vs. Pre-Diagnosis Period	1.00 (0.78, 1.28)	0.9916
Post-Diagnosis Period vs. Pre-Diagnosis Period	1.37 (1.10, 1.71)	0.0052
Post-Diagnosis Period vs. Peri-Diagnosis Period	1.37 (1.07, 1.75)	0.0110

Bold values indicate a statistically significant effect at $\alpha=0.05$

Appendix Table 3.2: Poisson Regression Model Results for Emergency Department Use, Colorectal Cancer Cohort and Matched Cancer-Free Cohort

Winnipeg residents, 2007/08-2010/11

Model Covariates	Relative Rate (95% Confidence Interval)	p-value
Intercept	0.02 (0.02, 0.03)	< 0.0001
Month of Diagnosis	0.99 (0.99, 1.00)	0.1207
Cancer Cohort (ref = Matched Cancer-Free Cohort)	1.18 (1.01, 1.37)	0.0381
Time Period (ref = Pre-Diagnosis)		
Peri-Diagnosis Period	1.17 (0.94, 1.46)	0.1657
Post-Diagnosis Period	1.21 (1.00, 1.47)	0.0505
Interaction of Cohort and Time Period (ref = Matched Cancer-Free Cohort in Pre-Diagnosis Period)		
Cancer Cohort in Peri-Diagnosis Period	2.07 (1.60, 2.68)	< 0.0001
Cancer Cohort in Post-Diagnosis Period	1.19 (0.99, 1.43)	0.0635
Age	1.00 (0.99, 1.00)	0.0455
Sex (ref = Female)	0.94 (0.87, 1.02)	0.1299
Income Quintile (ref = Q5 (highest))		
Q1 (lowest)	1.57 (1.38, 1.78)	< 0.0001
Q2	1.53 (1.34, 1.75)	< 0.0001
Q3	1.35 (1.18, 1.54)	< 0.0001
Q4	1.17 (1.01, 1.34)	0.0317
Income Unknown	0.95 (0.77, 1.17)	0.6217
Charlson Index	1.17 (1.14, 1.19)	< 0.0001
Number of Inpatient Hospitalizations	3.23 (3.02, 3.46)	< 0.0001
Majority of Care	0.86 (0.79, 0.93)	< 0.0001
Number of Ambulatory Physician Visits	1.31 (1.29, 1.34)	< 0.0001
Number of Prescription Drug Dispensations	1.03 (1.03, 1.03)	< 0.0001
Comparison Tests	Relative Rate (95% Confidence Interval)	p-value
Cancer Cohort vs. Matched Cancer-Free Cohort		
Overall	1.59 (1.28, 1.98)	< 0.0001
Pre-Diagnosis Period	1.18 (0.92, 1.50)	0.1886
Peri-Diagnosis Period	2.44 (1.72, 3.45)	< 0.0001
Post-Diagnosis Period	1.40 (1.11, 1.76)	0.0047
Cancer Cohort: Comparison of Time Periods		
Peri-Diagnosis Period vs. Pre-Diagnosis Period	2.43 (2.04, 2.88)	< 0.0001
Post-Diagnosis Period vs. Pre-Diagnosis Period	1.44 (1.17, 1.77)	0.0005
Post-Diagnosis Period vs. Peri-Diagnosis Period	0.59 (0.52, 0.68)	< 0.0001
Matched Cancer-Free Cohort: Comparison of Time Periods		
Peri-Diagnosis Period vs. Pre-Diagnosis Period	1.17 (0.87, 1.58)	0.3059
Post-Diagnosis Period vs. Pre-Diagnosis Period	1.21 (0.99, 1.48)	0.0613
Post-Diagnosis Period vs. Peri-Diagnosis Period	1.04 (0.74, 1.45)	0.8377

Bold values indicate a statistically significant effect at $\alpha=0.05$

Appendix Table 3.4: Poisson Regression Model Results for Emergency Department Use, Prostate Cancer Cohort and Matched Cancer-Free Cohort

Winnipeg residents, 2007/08-2010/11

Model Covariates	Relative Rate (95% Confidence Interval)	p-value
Intercept	0.00 (0.00, 0.00)	< 0.0001
Month of Diagnosis	1.00 (0.99, 1.00)	0.3507
Cancer Cohort (ref = Matched Cancer-Free Cohort)	1.14 (0.97, 1.35)	0.1161
Time Period (ref = Pre-Diagnosis)		
Peri-Diagnosis Period	0.65 (0.48, 0.89)	0.0068
Post-Diagnosis Period	1.11 (0.90, 1.38)	0.3365
Interaction of Cohort and Time Period (ref = Matched Cancer-Free Cohort in Pre-Diagnosis Period)		
Cancer Cohort in Peri-Diagnosis Period	2.71 (1.91, 3.84)	< 0.0001
Cancer Cohort in Post-Diagnosis Period	1.05 (0.86, 1.28)	0.6541
Age	1.02 (1.01, 1.02)	< 0.0001
Income Quintile (ref = Q5 (highest))		
Q1 (lowest)	1.78 (1.55, 2.04)	< 0.0001
Q2	1.20 (1.03, 1.39)	0.0183
Q3	1.21 (1.04, 1.40)	0.0138
Q4	1.11 (0.96, 1.29)	0.1634
Income Unknown	0.82 (0.66, 1.04)	0.0960
Charlson Index	1.20 (1.16, 1.23)	< 0.0001
Number of Inpatient Hospitalizations	5.41 (4.98, 5.89)	< 0.0001
Majority of Care	0.96 (0.88, 1.05)	0.4009
Number of Ambulatory Physician Visits	1.38 (1.35, 1.42)	< 0.0001
Number of Prescription Drug Dispensations	1.02 (1.01, 1.02)	< 0.0001
Comparison Tests	Relative Rate (95% Confidence Interval)	p-value
Cancer Cohort vs. Matched Cancer-Free Cohort		
Overall	1.62 (1.35, 1.94)	< 0.0001
Pre-Diagnosis Period	1.14 (0.93, 1.41)	0.2157
Peri-Diagnosis Period	3.10 (2.14, 4.47)	< 0.0001
Post-Diagnosis Period	1.20 (0.98, 1.46)	0.0842
Cancer Cohort: Comparison of Time Periods		
Peri-Diagnosis Period vs. Pre-Diagnosis Period	1.77 (1.42, 2.20)	< 0.0001
Post-Diagnosis Period vs. Pre-Diagnosis Period	1.16 (0.93, 1.46)	0.1934
Post-Diagnosis Period vs. Peri-Diagnosis Period	0.66 (0.53, 0.82)	0.0002
Matched Cancer-Free Cohort: Comparison of Time Periods		
Peri-Diagnosis Period vs. Pre-Diagnosis Period	0.65 (0.47, 0.91)	0.0126
Post-Diagnosis Period vs. Pre-Diagnosis Period	1.11 (0.84, 1.46)	0.4565
Post-Diagnosis Period vs. Peri-Diagnosis Period	1.70 (1.18, 2.46)	0.0043

Bold values indicate a statistically significant effect at $\alpha=0.05$

Regression Model Results for Cancer Cohorts

Appendix Table 3.5: Poisson Regression Model Results for Emergency Department Use, Breast Cancer Cohort

Winnipeg residents, 2007/08-2010/11

Model Covariates	Relative Rate (95% Confidence Interval)	p-value
Intercept	0.01 (0.00, 0.02)	<0.0001
Month of Diagnosis	0.98 (0.97, 0.99)	0.0008
Time Period (ref = Pre-Diagnosis)		
Peri-Diagnosis Period	9.89 (4.77, 20.50)	<0.0001
Post-Diagnosis Period	6.80 (3.22, 14.36)	<0.0001
Age	1.00 (1.00, 1.01)	0.8312
Sex (ref = Female)	1.29 (0.76, 2.17)	0.3422
Income Quintile (ref = Q5 (highest))		
Q1 (lowest)	1.48 (1.22, 1.79)	<0.0001
Q2	1.47 (1.21, 1.79)	0.0001
Q3	1.34 (1.10, 1.64)	0.0041
Q4	1.26 (1.03, 1.54)	0.0230
Income Unknown	1.02 (0.78, 1.34)	0.8812
Charlson Index	1.22 (1.16, 1.28)	<0.0001
Number of Inpatient Hospitalizations	3.69 (3.31, 4.11)	<0.0001
Majority of Care	0.98 (0.88, 1.10)	0.7654
Number of Ambulatory Physician Visits	1.26 (1.22, 1.30)	<0.0001
Number of Prescription Drug Dispensations	1.02 (1.02, 1.03)	<0.0001
Cancer Stage (ref = Stage 4)		
Stage 1	2.88 (1.40, 5.93)	0.0040
Stage 2	2.69 (1.31, 5.52)	0.0071
Stage 3	1.81 (0.80, 4.07)	0.1523
Unknown Stage	2.42 (0.88, 6.63)	0.0863
Chemotherapy Treatment	0.98 (0.84, 1.15)	0.8116
Hormone Therapy Treatment	0.80 (0.71, 0.90)	0.0002
Radiation Therapy Treatment	0.89 (0.78, 1.02)	0.0874
Surgical Intervention	0.84 (0.66, 1.06)	0.1377
Interactions of Cancer Stage and Time Period (ref = Stage 4, Pre-Diagnosis Period)	Relative Rate (95% Confidence Interval)	p-value
Stage 1*Peri-Diagnosis Period	0.08 (0.04, 0.19)	<0.0001
Stage 1*Post-Diagnosis Period	0.22 (0.10, 0.47)	<0.0001
Stage 2*Peri-Diagnosis Period	0.17 (0.08, 0.37)	<0.0001
Stage 2*Post-Diagnosis Period	0.31 (0.14, 0.66)	0.0024
Stage 3*Peri-Diagnosis Period	0.37 (0.15, 0.89)	0.0265
Stage 3*Post-Diagnosis Period	0.60 (0.26, 1.42)	0.2472
Unknown Cancer Stage*Peri-Diagnosis Period	0.24 (0.07, 0.84)	0.0251
Unknown Cancer Stage*Post-Diagnosis Period	0.18 (0.05, 0.61)	0.0061

Bold values indicate statistically significant effect at $\alpha=0.05$

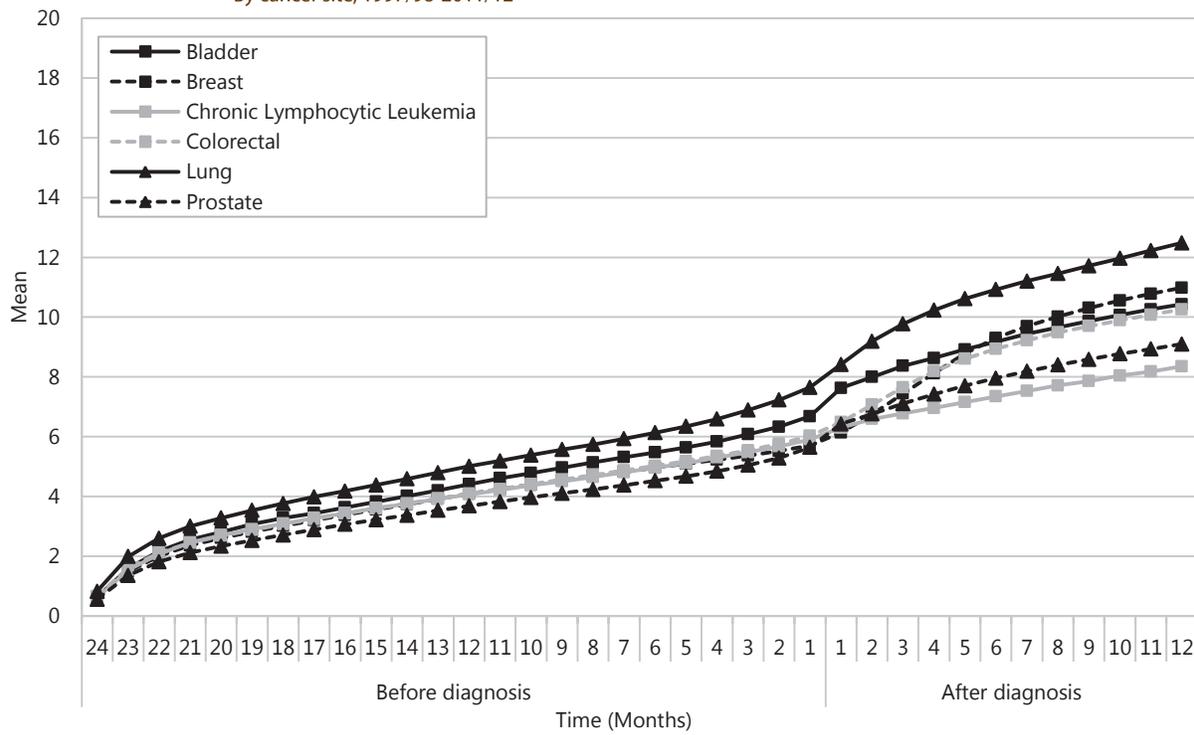
APPENDIX 4: COX PROPORTIONAL HAZARDS REGRESSION MODEL RESULTS FOR DEATH AFTER CANCER DIAGNOSIS

Appendix Table 4.1: Results for Cox Proportional Hazards Regression Model for Death after Breast Cancer Diagnosis
Winnipeg residents, 2007/08-2011/12

Model Covariates	Hazard Ratio (95% Confidence Interval)	p-value
Age (deciles)	1.33 (1.21, 1.45)	<0.0001
Sex (ref = Female)	0.53 (0.12, 2.30)	0.3961
Income Quintile (ref = Q5 (highest))		
Q1 (lowest)	1.05 (0.72, 1.54)	0.8085
Q2	0.75 (0.50, 1.13)	0.1645
Q3	0.73 (0.48, 1.10)	0.1356
Q4	0.80 (0.52, 1.24)	0.3172
Income Unknown	1.29 (0.81, 2.06)	0.2865
Cancer Stage (ref = Stage 1)		
Stage 2	2.19 (1.48, 3.25)	<0.0001
Stage 3	6.68 (4.44, 10.04)	<0.0001
Stage 4	27.45 (18.41, 40.91)	<0.0001
Unknown Stage	13.25 (7.73, 22.71)	<0.0001
Weighted Cancer-free Charlson Comorbidity Score	1.22 (1.08, 1.39)	0.0020
Number of Emergency Department Visits		
Pre-diagnosis (1 year before diagnosis)	0.98 (0.93, 1.04)	0.5425
Post-diagnosis (time-varying, every six months)	1.27 (1.18, 1.37)	<0.0001
Number of Inpatient Hospitalizations		
Pre-diagnosis (1 year before diagnosis)	0.93 (0.85, 1.02)	0.1293
Post-diagnosis (time-varying, every six months)	3.52 (3.06, 4.06)	<0.0001
Number of Ambulatory Physician Visits		
Pre-diagnosis (1 year before diagnosis)	1.02 (1.00, 1.04)	0.0654
Post-diagnosis (time-varying, every six months)	0.75 (0.71, 0.78)	<0.0001
Number of Drug Prescription Dispensations (scaled in groups of 10)		
Pre-diagnosis (1 year before diagnosis)	1.06 (1.04, 1.09)	<0.0001
Post-diagnosis (time-varying, every six months)	0.90 (0.85, 0.95)	0.0002

Bold values indicate a significant effect at $\alpha=0.05$

Appendix Figure 5.2: Cumulative Mean Number of New Prescription Drugs Dispensations for the Cancer Cohort, Including Cancer-Related Drugs
By cancer site, 1997/98-2011/12



Appendix Table 6.2: Reclassification Statistics for Logistic Regression Models Predicting In-Hospital Mortality

By cancer site, 1997/98-2011/12

Models	Integrated Discrimination Improvement (95% Confidence Interval)	Net Reclassification Improvement (95% Confidence Interval)	% of Events Correctly Reclassified	% of Non-Events Correctly Reclassified
Bladder				
No. of diagnoses	0.002 (-0.002, 0.005)	0.128 (-0.005, 0.262)	-12.3	25.1
No. of drugs	0.001 (-0.002, 0.004)	0.083 (-0.050, 0.217)	-13.0	21.3
No. of ADGs®	0.001 (-0.002, 0.004)	0.156 (0.022, 0.291)	-1.1	16.8
Resource Utilization Bands	0.002 (-0.002, 0.005)	0.209 (0.075, 0.343)	-4.8	25.7
Chronic Disease Score	0.000 (0.000, 0.000)	0.048 (-0.086, 0.183)	-10.0	14.9
Charlson Index	0.002 (-0.002, 0.006)	0.079 (-0.057, 0.214)	4.8	3.0
Elixhauser Index	0.047 (0.030, 0.065)	0.397 (0.266, 0.527)	-12.3	51.9
Breast				
No. of diagnoses	0.001 (-0.002, 0.005)	0.055 (-0.048, 0.159)	-17.1	22.7
No. of drugs	0.001 (-0.001, 0.003)	0.073 (-0.030, 0.177)	-16.6	23.9
No. of ADGs®	0.001 (-0.002, 0.003)	0.110 (0.005, 0.215)	-6.1	17.1
Resource Utilization Bands	0.002 (-0.001, 0.004)	0.077 (-0.029, 0.182)	-4.4	12.1
Chronic Disease Score	0.002 (-0.001, 0.004)	0.157 (0.052, 0.262)	-7.7	23.4
Charlson Index	0.014 (0.005, 0.023)	0.258 (0.153, 0.363)	-5.0	30.8
Elixhauser Index	0.027 (0.015, 0.038)	0.445 (0.340, 0.550)	3.9	40.6
Chronic Lymphocytic Leukemia				
No. of diagnoses	0.019 (0.001, 0.037)	0.383 (0.099, 0.668)	4.0	34.3
No. of drugs	0.006 (-0.005, 0.017)	0.211 (-0.072, 0.494)	-12.0	33.1
No. of ADGs®	0.010 (-0.002, 0.023)	0.212 (-0.074, 0.497)	0.0	21.2
Resource Utilization Bands	0.011 (-0.002, 0.023)	0.411 (0.127, 0.695)	8.0	33.1
Chronic Disease Score	0.008 (-0.004, 0.021)	0.246 (-0.038, 0.530)	-8.0	32.6
Charlson Index	0.006 (-0.006, 0.018)	0.243 (-0.041, 0.528)	8.0	16.3
Elixhauser Index	0.046 (0.015, 0.076)	0.489 (0.206, 0.773)	8.0	40.9
Colorectal				
No. of diagnoses	0.002 (0.000, 0.004)	0.106 (0.048, 0.165)	-11.6	22.3
No. of drugs	0.001 (0.000, 0.001)	0.118 (0.059, 0.177)	-7.6	19.4
No. of ADGs®	0.003 (0.001, 0.004)	0.141 (0.082, 0.201)	-2.4	16.6
Resource Utilization Bands	0.004 (0.002, 0.007)	0.296 (0.238, 0.355)	-4.4	34.1
Chronic Disease Score	0.001 (0.000, 0.001)	0.074 (0.015, 0.133)	-8.7	16.1
Charlson Index	0.008 (0.004, 0.011)	0.097 (0.038, 0.156)	-6.1	15.8
Elixhauser Index	0.017 (0.012, 0.021)	0.250 (0.191, 0.309)	-3.4	28.4
Lung				
No. of diagnoses	0.000 (0.000, 0.000)	-0.004 (-0.046, 0.038)	15.1	-15.5
No. of drugs	0.000 (0.000, 0.001)	0.035 (-0.007, 0.077)	15.2	-11.6
No. of ADGs®	0.000 (0.000, 0.000)	0.017 (-0.026, 0.059)	8.3	-6.6
Resource Utilization Bands	0.000 (0.000, 0.001)	0.066 (0.024, 0.109)	-2.3	8.9
Chronic Disease Score	0.000 (0.000, 0.000)	0.010 (-0.032, 0.053)	9.2	-8.2
Charlson Index	0.001 (0.000, 0.001)	-0.018 (-0.060, 0.024)	-21.6	19.8
Elixhauser Index	0.008 (0.006, 0.010)	0.125 (0.083, 0.168)	-5.3	17.9
Prostate				
No. of diagnoses	0.008 (0.004, 0.013)	0.273 (0.166, 0.380)	-2.6	29.9
No. of drugs	0.006 (0.003, 0.010)	0.268 (0.161, 0.376)	-0.3	27.1
No. of ADGs®	0.009 (0.004, 0.013)	0.302 (0.195, 0.409)	5.4	24.7
Resource Utilization Bands	0.006 (0.002, 0.009)	0.457 (0.350, 0.564)	4.3	41.4
Chronic Disease Score	0.005 (0.002, 0.008)	0.220 (0.113, 0.327)	-1.4	23.4
Charlson Index	0.017 (0.010, 0.025)	0.285 (0.178, 0.392)	4.9	23.6
Elixhauser Index	0.035 (0.024, 0.046)	0.400 (0.294, 0.506)	-10.0	50.0

Bold values indicate a statistically significant difference from the base model at $\alpha=0.05$

ADG® indicates Aggregated Diagnosis Groups™

Predictive Models for Healthcare Use

Appendix Table 6.3: Reclassification Statistics for Logistic Regression Models Predicting Incident Hospitalization

By cancer site, 1997/98-2011/12

Models	Integrated Discrimination Improvement (95% Confidence Interval)	Net Reclassification Improvement (95% Confidence Interval)	% of Events Correctly Reclassified	% of Non-Events Correctly Reclassified
Bladder				
No. of diagnoses	0.008 (0.002, 0.014)	0.129 (-0.015, 0.273)	-9.4	22.4
No. of drugs	0.004 (0.000, 0.009)	0.051 (-0.094, 0.196)	-11.8	16.9
No. of ADGs®	0.005 (0.000, 0.010)	0.148 (0.003, 0.294)	-2.0	16.9
Resource Utilization Bands	0.003 (-0.001, 0.008)	0.104 (-0.034, 0.243)	-25.3	35.7
Chronic Disease Score	0.001 (-0.001, 0.003)	-0.025 (-0.171, 0.120)	-13.1	10.6
Charlson Index	0.005 (0.000, 0.010)	0.129 (-0.017, 0.276)	2.4	10.6
Elixhauser Index	0.026 (0.016, 0.037)	0.156 (0.013, 0.300)	-9.1	24.7
Breast				
No. of diagnoses	0.002 (0.001, 0.003)	0.094 (0.043, 0.144)	-13.9	23.3
No. of drugs	0.001 (0.000, 0.001)	0.057 (0.007, 0.108)	-16.2	21.9
No. of ADGs®	0.002 (0.001, 0.004)	0.096 (0.045, 0.147)	-7.1	16.6
Resource Utilization Bands	0.002 (0.001, 0.003)	0.075 (0.024, 0.127)	5.6	2.0
Chronic Disease Score	0.000 (0.000, 0.001)	0.032 (-0.019, 0.083)	-15.5	18.8
Charlson Index	0.005 (0.003, 0.007)	0.149 (0.100, 0.199)	-15.5	30.4
Elixhauser Index	0.014 (0.011, 0.017)	0.211 (0.162, 0.261)	-11.2	32.3
Chronic Lymphocytic Leukemia				
No. of diagnoses	0.008 (-0.001, 0.018)	0.245 (0.076, 0.414)	-6.0	30.5
No. of drugs	0.021 (0.007, 0.036)	0.277 (0.108, 0.446)	-4.8	32.5
No. of ADGs®	0.006 (-0.002, 0.014)	0.214 (0.044, 0.384)	1.2	20.2
Resource Utilization Bands	0.004 (-0.003, 0.010)	0.084 (-0.083, 0.251)	-19.0	27.5
Chronic Disease Score	0.017 (0.004, 0.030)	0.244 (0.075, 0.414)	-2.4	26.8
Charlson Index	0.006 (-0.002, 0.014)	0.088 (-0.083, 0.258)	-7.1	15.9
Elixhauser Index	0.068 (0.044, 0.091)	0.541 (0.374, 0.708)	10.7	43.4
Colorectal				
No. of diagnoses	0.007 (0.003, 0.011)	0.265 (0.161, 0.370)	-2.7	29.2
No. of drugs	0.004 (0.002, 0.007)	0.187 (0.082, 0.292)	-7.6	26.3
No. of ADGs®	0.006 (0.002, 0.009)	0.250 (0.144, 0.357)	2.2	22.8
Resource Utilization Bands	0.010 (0.006, 0.015)	0.321 (0.222, 0.421)	-10.0	42.1
Chronic Disease Score	0.003 (0.001, 0.006)	0.204 (0.099, 0.310)	-5.9	26.3
Charlson Index	0.008 (0.004, 0.013)	0.415 (0.319, 0.512)	-6.4	48.0
Elixhauser Index	0.033 (0.025, 0.041)	0.550 (0.457, 0.644)	1.8	53.2
Lung				
No. of diagnoses	0.010 (0.006, 0.014)	0.185 (0.107, 0.264)	-5.6	24.1
No. of drugs	0.007 (0.004, 0.010)	0.097 (0.018, 0.177)	-7.3	17.0
No. of ADGs®	0.006 (0.003, 0.009)	0.143 (0.064, 0.223)	0.1	14.2
Resource Utilization Bands	0.002 (0.000, 0.004)	0.180 (0.100, 0.260)	18.5	-0.5
Chronic Disease Score	0.006 (0.003, 0.009)	0.174 (0.094, 0.253)	-2.2	19.5
Charlson Index	0.004 (0.001, 0.007)	0.172 (0.093, 0.251)	-1.9	19.0
Elixhauser Index	0.021 (0.015, 0.027)	0.297 (0.221, 0.374)	-6.8	36.5
Prostate				
No. of diagnoses	0.002 (0.001, 0.003)	0.077 (0.030, 0.123)	-14.8	22.4
No. of drugs	0.001 (0.000, 0.002)	0.051 (0.004, 0.097)	-13.9	19.0
No. of ADGs®	0.001 (0.001, 0.002)	0.076 (0.029, 0.123)	-8.4	15.9
Resource Utilization Bands	0.002 (0.001, 0.003)	0.204 (0.160, 0.249)	-23.1	43.5
Chronic Disease Score	0.001 (0.001, 0.002)	0.077 (0.031, 0.124)	-10.3	18.0
Charlson Index	0.002 (0.001, 0.003)	0.067 (0.020, 0.114)	-9.6	16.3
Elixhauser Index	0.013 (0.011, 0.016)	0.354 (0.310, 0.399)	-9.8	45.2

Bold values indicate a statistically significant difference from the base model at $\alpha=0.05$

ADG® indicates Aggregated Diagnosis Groups™

Predictive Models for Acute and Chronic Health Outcomes

Appendix Table 6.4: Reclassification Statistics for Logistic Regression Models Predicting Incident Hypertension
By cancer site, 1997/98-2011/12

Models	Integrated Discrimination Improvement (95% Confidence Interval)	Net Reclassification Improvement (95% Confidence Interval)	% of Events Correctly Reclassified	% of Non-Events Correctly Reclassified
Bladder				
No. of diagnoses	0.012 (0.000, 0.025)	0.289 (0.058, 0.521)	0.0	28.9
No. of drugs	0.052 (0.023, 0.081)	0.415 (0.184, 0.645)	6.8	34.7
No. of ADGs®	0.013 (0.001, 0.025)	0.295 (0.062, 0.527)	6.8	22.6
Resource Utilization Bands	0.003 (-0.002, 0.008)	0.148 (-0.077, 0.374)	-22.7	37.5
Chronic Disease Score	0.042 (0.017, 0.066)	0.358 (0.127, 0.589)	4.5	31.2
Charlson Index	0.005 (-0.002, 0.011)	0.129 (-0.105, 0.362)	4.5	8.3
Elixhauser	0.049 (0.023, 0.076)	0.455 (0.225, 0.684)	11.4	34.1
Breast				
No. of diagnoses	0.003 (0.001, 0.005)	0.084 (0.004, 0.163)	-14.2	22.5
No. of drugs	0.018 (0.013, 0.024)	0.328 (0.249, 0.408)	-1.6	34.4
No. of ADGs®	0.002 (0.000, 0.003)	0.075 (-0.006, 0.155)	-7.2	14.6
Resource Utilization Bands	0.001 (0.000, 0.003)	-0.195 (-0.275, -0.115)	0.1	-19.6
Chronic Disease Score	0.029 (0.022, 0.036)	0.417 (0.338, 0.497)	5.4	36.3
Charlson Index	0.001 (0.000, 0.003)	0.140 (0.060, 0.219)	-13.6	27.5
Elixhauser	0.035 (0.027, 0.043)	0.432 (0.355, 0.509)	-20.9	64.1
Chronic Lymphocytic Leukemia				
No. of diagnoses	0.000 (-0.002, 0.002)	0.062 (-0.215, 0.339)	20.0	-13.8
No. of drugs	0.031 (0.011, 0.050)	0.393 (0.113, 0.673)	5.5	33.8
No. of ADGs®	0.000 (-0.002, 0.002)	0.190 (-0.085, 0.466)	23.6	-4.6
Resource Utilization Bands	0.001 (-0.001, 0.002)	0.081 (-0.199, 0.361)	12.7	-4.6
Chronic Disease Score	0.028 (0.008, 0.048)	0.424 (0.145, 0.704)	9.1	33.3
Charlson Index	0.000 (-0.001, 0.001)	0.061 (-0.220, 0.341)	12.7	-6.7
Elixhauser	0.035 (0.014, 0.056)	0.324 (0.046, 0.603)	-9.1	41.5
Colorectal				
No. of diagnoses	0.006 (0.003, 0.009)	0.124 (0.040, 0.208)	-9.0	21.4
No. of drugs	0.048 (0.038, 0.057)	0.384 (0.301, 0.468)	3.7	34.7
No. of ADGs®	0.002 (0.000, 0.004)	0.065 (-0.019, 0.149)	-7.8	14.3
Resource Utilization Bands	0.001 (0.000, 0.002)	-0.051 (-0.132, 0.030)	-29.2	24.1
Chronic Disease Score	0.064 (0.053, 0.075)	0.474 (0.391, 0.557)	9.5	37.9
Charlson Index	0.004 (0.002, 0.007)	0.067 (-0.017, 0.151)	-11.3	18.0
Elixhauser	0.060 (0.049, 0.072)	0.419 (0.337, 0.501)	-10.1	52.0
Lung				
No. of diagnoses	0.009 (0.002, 0.015)	0.141 (-0.002, 0.283)	-7.0	21.1
No. of drugs	0.051 (0.035, 0.067)	0.426 (0.285, 0.568)	7.0	35.6
No. of ADGs®	0.006 (0.001, 0.011)	0.181 (0.039, 0.324)	2.6	15.5
Resource Utilization Bands	0.006 (0.001, 0.010)	0.212 (0.073, 0.352)	25.4	-4.2
Chronic Disease Score	0.063 (0.045, 0.080)	0.482 (0.342, 0.623)	14.9	33.3
Charlson Index	0.008 (0.002, 0.014)	0.177 (0.034, 0.320)	-0.9	18.6
Elixhauser	0.077 (0.056, 0.097)	0.566 (0.427, 0.705)	-0.9	57.5
Prostate				
No. of diagnoses	0.006 (0.003, 0.009)	0.132 (0.049, 0.216)	-10.6	23.8
No. of drugs	0.026 (0.020, 0.031)	0.364 (0.280, 0.448)	0.9	35.5
No. of ADGs®	0.004 (0.002, 0.007)	0.139 (0.055, 0.223)	-5.0	18.9
Resource Utilization Bands	0.000 (0.000, 0.001)	-0.017 (-0.096, 0.061)	-36.8	35.0
Chronic Disease Score	0.034 (0.028, 0.041)	0.415 (0.332, 0.499)	6.5	35.0
Charlson Index	0.000 (0.000, 0.001)	0.071 (-0.013, 0.155)	-9.0	16.1
Elixhauser	0.025 (0.019, 0.031)	0.241 (0.161, 0.321)	-25.2	49.3

Bold values indicate a statistically significant difference from the base model at $\alpha=0.05$

ADG® indicates Aggregated Diagnosis Groups™

Appendix Table 6.5: Reclassification Statistics for Logistic Regression Models Predicting Incident Diabetes

By cancer site, 1997/98-2011/12

Models	Integrated Discrimination Improvement (95% Confidence Interval)	Net Reclassification Improvement (95% Confidence Interval)	% of Events Correctly Reclassified	% of Non-Events Correctly Reclassified
Bladder				
No. of diagnoses	0.000 (-0.002, 0.002)	0.156 (-0.200, 0.511)	31.0	-15.5
No. of drugs	0.005 (-0.004, 0.015)	0.164 (-0.207, 0.535)	-10.3	26.8
No. of ADGs®	0.000 (-0.001, 0.001)	-0.080 (-0.453, 0.293)	3.4	-11.5
Resource Utilization Bands	0.000 (-0.003, 0.004)	0.114 (-0.248, 0.476)	-24.1	35.5
Chronic Disease Score	0.007 (-0.003, 0.017)	0.288 (-0.085, 0.660)	3.4	25.3
Charlson Index	0.000 (-0.001, 0.001)	-0.040 (-0.411, 0.332)	-10.3	6.4
Elixhauser Index	0.029 (0.001, 0.056)	0.509 (0.147, 0.871)	24.1	26.8
Breast				
No. of diagnoses	0.000 (0.000, 0.000)	0.001 (-0.130, 0.131)	-17.2	17.3
No. of drugs	0.003 (0.001, 0.006)	0.227 (0.095, 0.359)	-5.7	28.4
No. of ADGs®	0.000 (0.000, 0.000)	-0.028 (-0.160, 0.104)	8.4	-11.2
Resource Utilization Bands	0.000 (0.000, 0.000)	0.096 (-0.037, 0.228)	-0.4	10.0
Chronic Disease Score	0.005 (0.003, 0.008)	0.267 (0.135, 0.400)	-2.2	28.9
Charlson Index	0.000 (0.000, 0.000)	-0.059 (-0.188, 0.071)	20.7	-26.6
Elixhauser Index	0.018 (0.010, 0.026)	0.400 (0.268, 0.532)	5.7	34.3
Chronic Lymphocytic Leukemia				
No. of diagnoses	0.001 (-0.003, 0.005)	0.014 (-0.349, 0.378)	13.3	-11.9
No. of drugs	0.007 (-0.004, 0.018)	0.258 (-0.108, 0.624)	0.0	25.8
No. of ADGs®	0.001 (-0.004, 0.006)	0.107 (-0.257, 0.470)	13.3	-2.6
Resource Utilization Bands	0.005 (-0.003, 0.012)	0.022 (-0.341, 0.386)	-13.3	15.6
Chronic Disease Score	0.021 (0.004, 0.038)	0.525 (0.166, 0.883)	20.0	32.5
Charlson Index	0.003 (-0.001, 0.007)	0.014 (-0.352, 0.380)	6.7	-5.3
Elixhauser Index	0.048 (0.006, 0.090)	0.302 (-0.041, 0.645)	-33.3	63.6
Colorectal				
No. of diagnoses	0.001 (0.000, 0.001)	0.141 (0.011, 0.271)	-5.9	20.0
No. of drugs	0.009 (0.005, 0.012)	0.335 (0.205, 0.466)	6.7	26.8
No. of ADGs®	0.001 (0.000, 0.002)	0.092 (-0.039, 0.222)	-5.9	15.1
Resource Utilization Bands	0.000 (0.000, 0.001)	0.046 (-0.081, 0.173)	-22.7	27.3
Chronic Disease Score	0.009 (0.005, 0.013)	0.346 (0.216, 0.476)	8.4	26.2
Charlson Index	0.000 (0.000, 0.001)	0.023 (-0.106, 0.152)	-14.3	16.6
Elixhauser Index	0.023 (0.013, 0.032)	0.191 (0.066, 0.316)	-28.6	47.7
Lung				
No. of diagnoses	0.000 (-0.001, 0.001)	-0.127 (-0.353, 0.098)	1.3	-14.0
No. of drugs	0.001 (-0.001, 0.002)	0.068 (-0.156, 0.292)	-11.4	18.2
No. of ADGs®	0.002 (-0.001, 0.004)	0.020 (-0.205, 0.246)	3.8	-1.8
Resource Utilization Bands	0.001 (-0.001, 0.002)	0.048 (-0.177, 0.273)	-6.3	11.2
Chronic Disease Score	0.002 (-0.001, 0.004)	0.131 (-0.094, 0.357)	-3.8	16.9
Charlson Index	0.000 (-0.001, 0.002)	-0.038 (-0.260, 0.185)	-16.5	12.7
Elixhauser Index	0.077 (0.039, 0.116)	0.581 (0.358, 0.805)	8.9	49.2
Prostate				
No. of diagnoses	0.001 (0.000, 0.003)	0.004 (-0.128, 0.135)	-22.9	23.3
No. of drugs	0.010 (0.005, 0.016)	0.233 (0.098, 0.368)	-7.3	30.7
No. of ADGs®	0.001 (0.000, 0.001)	-0.003 (-0.137, 0.130)	-16.5	16.2
Resource Utilization Bands	0.001 (0.000, 0.003)	0.132 (0.004, 0.261)	-31.2	44.4
Chronic Disease Score	0.011 (0.007, 0.015)	0.391 (0.256, 0.525)	9.2	29.9
Charlson Index	0.001 (0.000, 0.002)	0.091 (-0.044, 0.226)	-9.2	18.3
Elixhauser Index	0.008 (0.004, 0.012)	0.385 (0.251, 0.519)	13.8	24.7

Bold values indicate a statistically significant difference from the base model at $\alpha=0.05$

ADG® indicates Aggregated Diagnosis Groups™

Appendix Table 6.6: Reclassification Statistics for Logistic Regression Models Predicting Incident Congestive Heart Failure

By cancer site, 1997/98-2011/12

Models	Integrated Discrimination Improvement (95% Confidence Interval)	Net Reclassification Improvement (95% Confidence Interval)	% of Events Correctly Reclassified	% of Non-Events Correctly Reclassified
Bladder				
No. of diagnoses	0.003 (-0.005, 0.012)	0.078 (-0.288, 0.445)	-17.2	25.1
No. of drugs	0.026 (0.006, 0.046)	0.427 (0.056, 0.798)	3.4	39.2
No. of ADGs®	0.001 (-0.003, 0.004)	0.098 (-0.269, 0.465)	17.2	-7.4
Resource Utilization Bands	0.001 (-0.003, 0.005)	0.167 (-0.193, 0.527)	-24.1	40.8
Chronic Disease Score	0.040 (0.009, 0.070)	0.598 (0.238, 0.959)	24.1	35.7
Charlson Index	0.000 (0.000, 0.000)	0.007 (-0.365, 0.379)	-3.4	4.2
Elixhauser Index	0.023 (0.003, 0.043)	0.386 (0.017, 0.756)	10.3	28.3
Breast				
No. of diagnoses	0.002 (-0.002, 0.005)	0.212 (0.059, 0.365)	-4.8	26.0
No. of drugs	0.012 (0.005, 0.018)	0.566 (0.415, 0.716)	16.7	39.9
No. of ADGs®	0.001 (-0.001, 0.004)	0.225 (0.072, 0.378)	2.4	20.1
Resource Utilization Bands	0.004 (0.000, 0.008)	0.070 (-0.081, 0.222)	-13.1	20.1
Chronic Disease Score	0.012 (0.005, 0.019)	0.546 (0.396, 0.697)	16.7	38.0
Charlson Index	0.004 (0.000, 0.009)	0.386 (0.234, 0.539)	9.5	29.1
Elixhauser Index	0.040 (0.024, 0.056)	0.609 (0.458, 0.760)	15.5	45.4
Chronic Lymphocytic Leukemia				
No. of diagnoses	0.004 (-0.006, 0.014)	0.224 (-0.089, 0.536)	-12.2	34.6
No. of drugs	0.019 (-0.002, 0.040)	0.556 (0.247, 0.866)	17.1	38.6
No. of ADGs®	0.003 (-0.006, 0.013)	0.141 (-0.172, 0.453)	-12.2	26.3
Resource Utilization Bands	0.002 (-0.004, 0.009)	0.245 (-0.067, 0.557)	-12.2	36.7
Chronic Disease Score	0.029 (0.008, 0.051)	0.553 (0.243, 0.863)	17.1	38.2
Charlson Index	0.003 (-0.006, 0.011)	0.088 (-0.226, 0.403)	-7.3	16.1
Elixhauser Index	0.061 (0.017, 0.105)	0.585 (0.273, 0.897)	-2.4	61.0
Colorectal				
No. of diagnoses	0.007 (0.003, 0.011)	0.134 (0.008, 0.261)	-11.2	24.6
No. of drugs	0.014 (0.008, 0.020)	0.383 (0.257, 0.510)	4.8	33.5
No. of ADGs®	0.003 (0.001, 0.005)	0.087 (-0.039, 0.214)	-8.8	17.5
Resource Utilization Bands	0.006 (0.002, 0.009)	0.251 (0.126, 0.376)	-16.8	41.9
Chronic Disease Score	0.016 (0.009, 0.022)	0.381 (0.254, 0.507)	5.6	32.5
Charlson Index	0.003 (0.000, 0.005)	0.095 (-0.031, 0.222)	-11.2	20.7
Elixhauser Index	0.026 (0.016, 0.036)	0.464 (0.337, 0.590)	0.0	46.4
Lung				
No. of diagnoses	0.004 (-0.001, 0.009)	0.208 (-0.001, 0.418)	-7.7	28.5
No. of drugs	0.010 (0.002, 0.018)	0.336 (0.126, 0.546)	3.3	30.3
No. of ADGs®	0.002 (-0.002, 0.007)	0.228 (0.018, 0.438)	3.3	19.5
Resource Utilization Bands	0.005 (0.000, 0.010)	0.336 (0.128, 0.543)	16.5	17.1
Chronic Disease Score	0.008 (0.001, 0.015)	0.415 (0.207, 0.623)	14.3	27.2
Charlson Index	0.003 (-0.002, 0.007)	0.395 (0.187, 0.604)	14.3	25.3
Elixhauser Index	0.049 (0.025, 0.074)	0.607 (0.400, 0.815)	14.3	46.4
Prostate				
No. of diagnoses	0.003 (0.000, 0.007)	0.252 (0.109, 0.394)	0.0	25.2
No. of drugs	0.008 (0.003, 0.012)	0.424 (0.282, 0.566)	10.3	32.0
No. of ADGs®	0.003 (0.000, 0.007)	0.261 (0.119, 0.404)	5.2	21.0
Resource Utilization Bands	0.004 (0.000, 0.008)	0.307 (0.166, 0.447)	-16.5	47.2
Chronic Disease Score	0.009 (0.004, 0.014)	0.450 (0.308, 0.591)	13.4	31.6
Charlson Index	0.001 (-0.001, 0.004)	0.174 (0.031, 0.317)	-1.0	18.4
Elixhauser Index	0.019 (0.009, 0.030)	0.479 (0.337, 0.622)	-2.1	50.0

Bold values indicate a statistically significant difference from the base model at $\alpha=0.05$

ADG® indicates Aggregated Diagnosis Groups™

Appendix Table 6.7: Reclassification Statistics for Logistic Regression Models Predicting Incident Acute Myocardial Infarction

By cancer site, 1997/98-2011/12

Models	Integrated Discrimination Improvement (95% Confidence Interval)	Net Reclassification Improvement (95% Confidence Interval)	% of Events Correctly Reclassified	% of Non-Events Correctly Reclassified
All Sites				
No. of diagnoses	0.000 (0.000, 0.001)	0.197 (0.075, 0.318)	-4.2	23.8
No. of drugs	0.001 (0.001, 0.002)	0.271 (0.150, 0.393)	-1.9	29.0
No. of Aggregated Diagnosis Groups™	0.000 (0.000, 0.001)	0.156 (0.035, 0.277)	-0.4	16.0
Resource Utilization Bands	0.000 (0.000, 0.001)	0.284 (0.162, 0.405)	2.7	25.7
Chronic Disease Score	0.001 (0.001, 0.002)	0.272 (0.151, 0.393)	1.1	26.0
Charlson Index	0.001 (0.000, 0.001)	0.267 (0.146, 0.389)	4.9	21.8
Elixhauser Index	0.003 (0.002, 0.004)	0.321 (0.199, 0.442)	1.9	30.2

Bold values indicate a statistically significant difference from the base model at $\alpha=0.05$

Appendix Table 6.8: Reclassification Statistics for Logistic Regression Models Predicting Incident Osteoporosis-Related Fractures

By cancer site, 1997/98-2011/12

Models	Integrated Discrimination Improvement (95% Confidence Interval)	Net Reclassification Improvement (95% Confidence Interval)	% of Events Correctly Reclassified	% of Non-Events Correctly Reclassified
Breast				
No. of diagnoses	0.002 (-0.001, 0.005)	0.131 (-0.087, 0.350)	-12.5	25.6
No. of drugs	0.000 (0.000, 0.001)	0.147 (-0.072, 0.367)	-10.0	24.7
No. of ADGs®	0.002 (0.000, 0.004)	0.186 (-0.034, 0.406)	-2.5	21.1
Resource Utilization Bands	0.001 (0.000, 0.002)	0.007 (-0.213, 0.226)	-7.5	8.2
Chronic Disease Score	0.000 (0.000, 0.000)	0.069 (-0.149, 0.288)	-12.5	19.4
Charlson Index	0.000 (0.000, 0.001)	0.346 (0.127, 0.564)	12.5	22.1
Elixhauser Index	0.016 (0.008, 0.025)	0.570 (0.351, 0.790)	7.5	49.5
Colorectal				
No. of diagnoses	0.000 (-0.001, 0.000)	0.097 (-0.102, 0.295)	-10.2	19.9
No. of drugs	0.001 (-0.001, 0.002)	0.157 (-0.042, 0.356)	-8.2	23.9
No. of ADGs®	0.000 (-0.001, 0.001)	0.206 (0.007, 0.406)	4.1	16.6
Resource Utilization Bands	0.001 (-0.001, 0.002)	0.300 (0.101, 0.499)	0.0	30.0
Chronic Disease Score	0.000 (-0.001, 0.001)	0.168 (-0.032, 0.367)	-2.0	18.8
Charlson Index	0.000 (0.000, 0.000)	0.024 (-0.173, 0.222)	12.2	-9.8
Elixhauser Index	0.003 (0.001, 0.005)	0.383 (0.201, 0.565)	40.8	-2.5
Lung				
No. of diagnoses	0.000 (0.000, 0.001)	0.063 (-0.116, 0.242)	-11.7	17.9
No. of drugs	0.000 (0.000, 0.000)	0.014 (-0.165, 0.192)	-15.0	16.4
No. of ADGs®	0.000 (0.000, 0.000)	0.021 (-0.159, 0.200)	-6.7	8.7
Resource Utilization Bands	0.000 (0.000, 0.000)	0.006 (-0.174, 0.186)	6.7	-6.0
Chronic Disease Score	0.000 (-0.001, 0.001)	0.094 (-0.086, 0.274)	-5.0	14.4
Charlson Index	0.000 (0.000, 0.000)	0.000 (-0.177, 0.176)	20.0	-20.0
Elixhauser Index	0.008 (0.004, 0.012)	0.489 (0.311, 0.666)	16.7	32.2
All Sites				
No. of diagnoses	0.001 (0.000, 0.001)	0.157 (0.057, 0.257)	-10.4	26.1
No. of drugs	0.000 (0.000, 0.001)	0.164 (0.064, 0.264)	-8.3	24.6
No. of ADGs®	0.001 (0.000, 0.002)	0.248 (0.148, 0.349)	5.2	19.7
Resource Utilization Bands	0.001 (0.000, 0.001)	0.265 (0.164, 0.365)	0.0	26.5
Chronic Disease Score	0.000 (0.000, 0.001)	0.186 (0.086, 0.287)	-2.1	20.7
Charlson Index	0.000 (0.000, 0.000)	0.100 (0.000, 0.201)	-5.7	15.7
Elixhauser Index	0.004 (0.002, 0.006)	0.350 (0.250, 0.450)	-6.7	41.8

Bold values indicate a statistically significant difference from the base model at $\alpha=0.05$

ADG® indicates Aggregated Diagnosis Groups™

Appendix Table 7.1: Measures of Discrimination & Prediction Error for Logistic Regression Models Predicting All-Cause Mortality (Comorbidity Measures Exclude Cancer-Related Diagnoses & Prescription Drugs)

By cancer site, 1997/98-2011/12

Models	c -statistic (95% Confidence Interval)	Brier score (Standard Deviation)	Δc (%)
Bladder			
Base	0.730 (0.699, 0.761)	0.180 (0.006)	--
No. of diagnoses	0.735 (0.705, 0.765)	0.179 (0.006)	0.005 (0.74)
No. of drugs	0.731 (0.701, 0.762)	0.180 (0.006)	0.001 (0.19)
No. of Aggregated Diagnosis Groups™	0.731 (0.701, 0.762)	0.180 (0.006)	0.001 (0.20)
Resource Utilization Bands	0.733 (0.702, 0.763)	0.179 (0.006)	0.003 (0.39)
Chronic Disease Score	0.730 (0.699, 0.760)	0.180 (0.006)	0.000 (-0.01)
Charlson Index	0.742 (0.712, 0.772)	0.176 (0.006)	0.012 (1.71)
Elixhauser Index	0.774 (0.745, 0.802)	0.167 (0.006)	0.044 (6.05)
Breast			
Base	0.898 (0.883, 0.913)	0.037 (0.002)	--
No. of diagnoses	0.900 (0.885, 0.915)	0.037 (0.002)	0.002 (0.18)
No. of drugs	0.901 (0.887, 0.916)	0.037 (0.002)	0.003 (0.34)
No. of Aggregated Diagnosis Groups™	0.899 (0.884, 0.914)	0.037 (0.002)	0.001 (0.12)
Resource Utilization Bands	0.898 (0.884, 0.913)	0.037 (0.002)	0.000 (0.02)
Chronic Disease Score	0.902 (0.887, 0.916)	0.037 (0.002)	0.003 (0.37)
Charlson Index	0.900 (0.885, 0.915)	0.037 (0.002)	0.002 (0.21)
Elixhauser Index	0.907 (0.892, 0.921)	0.037 (0.001)	0.008 (0.93)
Chronic Lymphocytic Leukemia			
Base	0.786 (0.730, 0.841)	0.065 (0.006)	--
No. of diagnoses	0.804 (0.749, 0.860)	0.064 (0.006)	0.019 (2.38)
No. of drugs	0.796 (0.742, 0.849)	0.065 (0.006)	0.010 (1.25)
No. of Aggregated Diagnosis Groups™	0.801 (0.746, 0.856)	0.065 (0.006)	0.015 (1.93)
Resource Utilization Bands	0.803 (0.745, 0.861)	0.062 (0.006)	0.018 (2.24)
Chronic Disease Score	0.791 (0.735, 0.847)	0.065 (0.006)	0.005 (0.66)
Charlson Index	0.794 (0.739, 0.849)	0.065 (0.006)	0.008 (1.03)
Elixhauser Index	0.838 (0.786, 0.889)	0.058 (0.006)	0.052 (6.60)
Colorectal			
Base	0.812 (0.800, 0.824)	0.125 (0.002)	--
No. of diagnoses	0.815 (0.803, 0.827)	0.124 (0.002)	0.003 (0.36)
No. of drugs	0.814 (0.802, 0.825)	0.125 (0.002)	0.001 (0.14)
No. of Aggregated Diagnosis Groups™	0.815 (0.803, 0.827)	0.124 (0.002)	0.003 (0.35)
Resource Utilization Bands	0.817 (0.805, 0.828)	0.124 (0.002)	0.004 (0.51)
Chronic Disease Score	0.813 (0.801, 0.825)	0.125 (0.002)	0.001 (0.12)
Charlson Index	0.816 (0.804, 0.828)	0.124 (0.002)	0.004 (0.46)
Elixhauser Index	0.820 (0.808, 0.832)	0.123 (0.002)	0.008 (0.97)
Lung			
Base	0.784 (0.774, 0.794)	0.174 (0.002)	--
No. of diagnoses	0.784 (0.774, 0.794)	0.174 (0.002)	0.000 (0.01)
No. of drugs	0.784 (0.774, 0.794)	0.174 (0.002)	0.000 (-0.01)
No. of Aggregated Diagnosis Groups™	0.784 (0.774, 0.794)	0.174 (0.002)	0.000 (0.00)
Resource Utilization Bands	0.785 (0.774, 0.795)	0.174 (0.002)	0.001 (0.07)
Chronic Disease Score	0.784 (0.774, 0.794)	0.174 (0.002)	0.000 (-0.04)
Charlson Index	0.784 (0.774, 0.794)	0.174 (0.002)	0.000 (-0.01)
Elixhauser Index	0.789 (0.779, 0.799)	0.173 (0.002)	0.005 (0.59)
Prostate			
Base	0.795 (0.773, 0.816)	0.052 (0.002)	--
No. of diagnoses	0.808 (0.788, 0.829)	0.051 (0.002)	0.014 (1.73)
No. of drugs	0.804 (0.783, 0.825)	0.051 (0.002)	0.009 (1.18)
No. of Aggregated Diagnosis Groups™	0.806 (0.785, 0.827)	0.052 (0.002)	0.011 (1.42)
Resource Utilization Bands	0.799 (0.778, 0.820)	0.052 (0.002)	0.004 (0.54)
Chronic Disease Score	0.806 (0.785, 0.826)	0.051 (0.002)	0.011 (1.36)
Charlson Index	0.809 (0.788, 0.830)	0.051 (0.002)	0.014 (1.79)
Elixhauser Index	0.816 (0.795, 0.836)	0.050 (0.002)	0.021 (2.64)

Bold values indicate a statistically significant difference from the base model at $\alpha=0.05$

Appendix Table 7.2: Reclassification Statistics for Logistic Regression Models Predicting All-Cause Mortality (Comorbidity Measures Exclude Cancer-Related Diagnoses & Prescription Drugs)

By cancer site, 1997/98-2011/12

Models	Integrated Discrimination Improvement (95% Confidence Interval)	Net Reclassification Improvement (95% Confidence Interval)	% of Events Correctly Reclassified	% of Non-Events Correctly Reclassified
Bladder				
No. of diagnoses	0.005 (0.000, 0.010)	0.101 (-0.018, 0.220)	-14.8	24.9
No. of drugs	0.002 (-0.001, 0.006)	0.121 (0.002, 0.241)	-11.1	23.2
No. of Aggregated Diagnosis Groups™	0.002 (-0.001, 0.004)	0.105 (-0.015, 0.225)	-6.9	17.4
Resource Utilization Bands	0.003 (-0.001, 0.007)	0.080 (-0.037, 0.197)	-22.8	30.8
Chronic Disease Score	0.000 (0.000, 0.000)	0.063 (-0.058, 0.183)	-9.0	15.3
Charlson Index	0.019 (0.010, 0.028)	0.208 (0.089, 0.328)	-6.9	27.7
Elixhauser Index	0.062 (0.045, 0.079)	0.458 (0.345, 0.571)	-14.3	60.1
Breast				
No. of diagnoses	0.002 (-0.001, 0.005)	0.098 (0.005, 0.191)	-13.2	23.0
No. of drugs	0.004 (-0.001, 0.008)	0.212 (0.119, 0.306)	-8.4	29.7
No. of Aggregated Diagnosis Groups™	0.001 (-0.002, 0.003)	0.094 (0.000, 0.187)	-6.7	16.1
Resource Utilization Bands	0.000 (-0.001, 0.001)	-0.182 (-0.275, -0.088)	1.9	-20.1
Chronic Disease Score	0.003 (-0.001, 0.007)	0.245 (0.151, 0.338)	-4.5	29.0
Charlson Index	0.005 (0.000, 0.009)	0.199 (0.108, 0.291)	-18.8	38.7
Elixhauser Index	0.015 (0.008, 0.023)	0.177 (0.087, 0.267)	-27.0	44.7
Chronic Lymphocytic Leukemia				
No. of diagnoses	0.017 (0.001, 0.032)	0.327 (0.077, 0.578)	0.0	32.7
No. of drugs	0.007 (-0.004, 0.018)	0.307 (0.057, 0.558)	-3.0	33.8
No. of Aggregated Diagnosis Groups™	0.014 (0.000, 0.027)	0.317 (0.067, 0.567)	9.1	22.6
Resource Utilization Bands	0.036 (0.013, 0.058)	0.341 (0.091, 0.592)	6.1	28.1
Chronic Disease Score	0.007 (-0.003, 0.017)	0.212 (-0.038, 0.463)	-6.1	27.3
Charlson Index	0.005 (-0.006, 0.016)	0.401 (0.151, 0.651)	6.1	34.0
Elixhauser Index	0.099 (0.053, 0.144)	0.723 (0.480, 0.967)	21.2	51.1
Colorectal				
No. of diagnoses	0.002 (0.001, 0.004)	0.126 (0.074, 0.178)	-11.2	23.8
No. of drugs	0.001 (0.000, 0.002)	0.126 (0.074, 0.178)	-8.5	21.1
No. of Aggregated Diagnosis Groups™	0.003 (0.001, 0.004)	0.164 (0.112, 0.217)	-1.5	18.0
Resource Utilization Bands	0.004 (0.002, 0.005)	0.079 (0.028, 0.130)	-18.7	26.6
Chronic Disease Score	0.001 (0.000, 0.002)	0.108 (0.056, 0.160)	-6.8	17.6
Charlson Index	0.002 (0.001, 0.004)	0.172 (0.120, 0.223)	-12.4	29.6
Elixhauser Index	0.010 (0.008, 0.013)	0.136 (0.085, 0.188)	-14.2	27.8
Lung				
No. of diagnoses	0.000 (0.000, 0.001)	0.034 (-0.009, 0.077)	-15.1	18.5
No. of drugs	0.000 (0.000, 0.000)	-0.001 (-0.044, 0.042)	-13.4	13.4
No. of Aggregated Diagnosis Groups™	0.000 (0.000, 0.000)	-0.022 (-0.065, 0.021)	7.9	-10.1
Resource Utilization Bands	0.000 (0.000, 0.001)	0.030 (-0.012, 0.073)	23.6	-20.5
Chronic Disease Score	0.000 (0.000, 0.001)	0.060 (0.017, 0.103)	-6.2	12.2
Charlson Index	0.000 (0.000, 0.000)	-0.066 (-0.109, -0.023)	-15.6	9.0
Elixhauser Index	0.004 (0.003, 0.005)	0.093 (0.050, 0.137)	2.8	6.5
Prostate				
No. of diagnoses	0.015 (0.008, 0.021)	0.303 (0.209, 0.398)	-2.4	32.7
No. of drugs	0.010 (0.006, 0.015)	0.321 (0.227, 0.416)	2.0	30.1
No. of Aggregated Diagnosis Groups™	0.010 (0.005, 0.015)	0.284 (0.189, 0.379)	4.2	24.2
Resource Utilization Bands	0.005 (0.002, 0.009)	0.066 (-0.027, 0.160)	-16.5	23.1
Chronic Disease Score	0.011 (0.006, 0.016)	0.304 (0.209, 0.398)	2.9	27.5
Charlson Index	0.019 (0.012, 0.027)	0.352 (0.258, 0.447)	-5.1	40.3
Elixhauser Index	0.035 (0.024, 0.045)	0.371 (0.277, 0.464)	-13.0	50.0

Bold values indicate a statistically significant difference from the base model at $\alpha=0.05$

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Manitoba Centre for Health Policy
University of Manitoba, College of Medicine
Faculty of Health Sciences
408-727 McDermot Avenue
Winnipeg, Manitoba R3E 3P5
Tel: (204) 789-3819
Fax: (204) 789-3910
Email: reports@cpe.umanitoba.ca
Web: umanitoba.ca/medicine/units/mchp

