PARKINSON'S DISEASE MORTALITY IN NOVA SCOTIA FROM 1998 TO 2005: A DESCRIPTIVE ANALYSIS USING BOTH UNDERLYING AND MULTIPLE CAUSES OF DEATH

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With associations between causes analysis added by
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NELS | Network for End of Life Studies
ICE | Interdisciplinary Capacity Enhancement

Introduction

With support from a Canadian Institutes of Health Research (CIHR) Interdisciplinary Capacity Enhancement (ICE) grant (#HOA-80067), the Network for End of Life Studies (NELS) is investigating end of life care for persons dying of chronic diseases. Phase One is an analysis of death certificate data from Nova Scotia Vital Statistics. This report focuses on **Parkinson's disease**, and is one of a series of reports from NELS ICE describing persons dying from specific chronic diseases in Nova Scotia.

Subsequent work will hopefully involve the linkage of NSVS data to administrative data from disease registries, palliative care program (PCP) databases, the Canadian Institute for Health Information (CIHI) hospital discharge abstract database, SEAscape (single entry access - continuing care), medication databases (e.g. Pharmacare) and physician billings (Appendix A).

Purpose

The purposes of this report are to:

- share a synthesis of Parkinson's disease findings from a descriptive analysis of Vital Statistics data;
- dialogue with persons interested in building research and surveillance to improve care available to people at end of life with Parkinson's disease;
- examine disparities in health service use for populations at risk for reduced access to quality end of life care; and
- report on an analyze of the strength of the associations between causes of death on the death certificate to further understand the interactions of disease at the time of death and assist in identifying issues in the coding of cause of death information.

Methods

Study subjects: The study population is Nova Scotia residents of all ages who died from January 1, 1998 to December 31, 2005 (N = 63,431). These decedents were identified from the NSVS death certificate database maintained by the Population Health Research Unit (PHRU) at Dalhousie University. While all deaths were included, the International Classification of Disease (ICD) codes for injuries, poisonings and other external causes of death were provided as XXX.

Classification of Parkinson's disease as a cause of death: Table 1 lists the International Classification of Diseases (ICD) codes for Parkinson's disease. From 1979 to 1999, causes of death were coded using the ninth revision of ICD (ICD-9). Since January 1, 2000, causes of death have been coded using the tenth revision of ICD (ICD-10).

Table 1: International Classification of Diseases (ICD) codes for Parkinson's disease

ICD-9 (1979-1999)	
332	Parkinson's disease
ICD-10 (2000-present)	
G20	Parkinson's disease
G21	Secondary parkinsonism

From the ICD-9 (http://icd9cm.chrisendres.com/index.php?action=child&recordid=2806), codes included are:

332 Parkinson's disease
Excludes: dementia with Parkinsonism (331.82)
332.0 Paralysis agitans
Parkinsonism or Parkinson's disease: Not otherwise specified
idiopathic
primary
332.1 Secondary Parkinsonism
Neuroleptic-induced Parkinsonism
Parkinsonism due to drugs Use additional E code to identify drug, if drug-induced
Excludes: Parkinsonism (in):
Huntington's disease (333.4)
progressive supranuclear palsy (333.0)
Shy-Drager syndrome (333.0)
syphilitic (094.82)

From the ICD-10 (http://apps.who.int/classifications/apps/icd/icd10online/gg20.htm), the codes included are:

G20	Parkinson's disease
	Hemiparkinsonism Paralysis agitans Parkinsonism or Parkinson's disease: · NOS · idiopathic · primary
G21	Secondary parkinsonism
G21.0	Malignant neuroleptic syndrome
	Use additional external cause code (Chapter XX), if desired, to identify drug.
G21.1	Other drug-induced secondary parkinsonism
	Use additional external cause code (Chapter XX), if desired, to identify drug.
G21.2	Secondary parkinsonism due to other external agents
	Use additional external cause code (Chapter XX), if desired, to identify external agent.
G21.3	Postencephalitic parkinsonism
G21.8	Other secondary parkinsonism
G21.9	Secondary parkinsonism, unspecified

Definitive diagnosis is only possible on autopsy. In Nova Scotia, autopsy rates are low. Therefore, confirmation of Parkinson's as a cause of death is rare.

As Parkinson's disease progresses, cognitive function, in addition to gait and movement are affected. People living with Parkinson's disease experience both severe physical and cognitive dysfunction. Thus, misclassification of Parkinson's disease and dementia to some unknown extent is probable. Our ability to distinguish among the different dementia-related disorders has been limited - and there has been a tendency to 'lump' these conditions together. The classification system as seen above in the changes from ICD-9 to ICD-10 is becoming more refined, but the actual coding practice takes time to 'catch up' in the use of the new codes.

While external causes of morbidity and mortality relating to falls, breaking hips and other accidents are relevant for Parkinson's disease, as noted earlier, ICD codes for external causes of death were not made available to us by PHRU so this is a limitation of the analysis in this report.

Multiple causes of death: There are up to 13 causes of death listed on the death certificate. When only one cause of death is recorded, this cause of death is selected as the underlying cause. When more than one cause of death is recorded, the underlying cause is identified using a set of rules developed by the World Health Organization (Statistics Canada, 2005). The underlying cause of death is defined by Statistics Canada (2007) as "(a) the disease or injury which initiated the train of morbid events leading directly to death, or (b) the circumstances of the accident or violence which produced the fatal injury." In order to gain a more complete understanding of the burden of Parkinson's disease, all records for which Parkinson's disease was mentioned as a cause of death on the death certificate were examined.

Associations between causes of death: Following Gorina and Lentzner (2008) the strength of association between causes of death is calculated as:

$$\frac{\text{Observed number of deaths with both causes A\&B}}{\text{Expected number of deaths with both causes A\&B}}$$

Where expected number of deaths based on the assumption of independence is:

$$\frac{\text{(deaths with cause A) x (deaths with cause B)}}{\text{Total deaths (all causes)}}$$

If the ratio of observed to expected is greater than 1, the association is stronger than expected while a value less than 1 indicates an association which is less than expected. The chi-squared statistic is calculated to test if the causes are independent using a 95% confidence level. The null hypothesis that the causes are independent is rejected if the test result is significant.

Results

Deaths with Parkinson's disease mentioned or selected as the underlying cause: Among the 63,431 persons who died in Nova Scotia from 1998 to 2005, 426 (0.67%) had Parkinson's disease as their underlying cause of death, and 908 (1.43%) had Parkinson's disease mentioned as one of their causes of death (Table 2). In other words, among every 100 persons that die in Nova Scotia, one or two will have Parkinson's disease mentioned as a disease that was associated with their death.

Parkinson's disease is reported more often in males than females. The number of deaths each year from Parkinson's disease remained fairly constant from 1998 to 2005 (Table 3). Parkinson's disease typically appears as a cause of death after age 65 and particularly after age 75 (Figure 1).

Table 2: Total deaths from Parkinson's disease, Nova Scotia, 1998-2005.

	N (% of total deaths)
Parkinson's disease selected as the underlying cause[1]	426 (0.67)
Parkinson's disease mentioned but not the underlying cause	482 (0.76)
Total mentions	908 (1.43)

[1] There were 8 records where Parkinson's disease was not listed as one of the up to 13 causes of death but was selected as the underlying cause of death. Further investigation is required to determine why Parkinson's disease was selected as the underlying cause for these records.

Table 3: Number of deaths with Parkinson's disease mentioned as a cause of death, by year of death, Nova Scotia, 1998-2005.

	1998	1999	2000	2001	2002	2003	2004	2005	TOTAL
Male	57	44	55	55	64	64	67	73	**479**
Female	29	46	48	61	65	44	78	58	**429**
Total **(% of total deaths)**	86 (1.1)	90 (1.2)	103 (1.3)	116 (1.5)	129 (1.6)	105 (1.4)	142 (1.8)	129 (1.6)	**908** **(1.4)**

Underlying causes of death with any mention of Parkinson's disease: Table 4 reports the underlying cause of death for those deaths where Parkinson's disease was mentioned as a cause of death. Over 50% did not have Parkinson's disease as the underlying cause but died of other conditions such as cancer, stroke or cardiovascular disease. Refer to the Appendix for a listing of the ICD codes used.

Table 4: Top ten underlying causes with Parkinson's disease mentioned anywhere on the death certificate, Nova Scotia, 1998-2005.

Disease	Number of Deaths	
	N	%
Parkinson's Disease	426	46.9
Cancer	63	6.9
Stroke	57	6.3
Alzheimer's disease and dementia	49	5.4
Chronic ischemic heart disease	48	5.3
Pneumonia	34	3.7
Acute myocardial infarction	27	3.0
Chronic obstructive pulmonary disease	21	2.3
Injury, poisoning and certain other consequences of external causes; External causes of morbidity and mortality	17	1.9
Pnuemonitis due to solids and liquids	13	1.4

Dying in-hospital: These vital statistics data, which were obtained from the Population Health Research Unit (PHRU), only report location of death as in-hospital or out-of-hospital. Using a more complete data set obtained directly from Nova Scotia Vital Statistics, out-of-hospital can be subdivided into private residence and nursing home.

Place of death has been used as an indicator of quality of care at end of life (Burge et al., 2003; Grunfeld et al., 2006; NELS ICE, 2008). Most persons would like to die in their own home or community based care rather than in-hospital if adequate home and community care is available (Grunfeld et al., 2008). In Nova Scotia, using the PHRU NSVS data from 1998 to 2005, 62.6% of all adult deaths occurred in-hospital. This rate of hospital death is considered relatively high compared to rates in other countries such as the US, UK and some other European countries.

For 1998 to 2005, 48.1% of all deaths where Parkinson's disease was mentioned on the death certificate occurred in-hospital (Table 6). The percentage dying in-hospital tends to decrease as age increases with 62.5.% dying in-hospital among those under 75 years, and 36.2% dying in-hospital among those 85 years and over.

Table 4: Number and percent of in-hospital deaths with Parkinson's disease mentioned or selected as the underlying cause, by age, Nova Scotia, 1998-2005.

	Aged <75		Aged 75-84		Aged 85+		Overall	
	N	%	N	%	N	%	N	%
Parkinson's disease selected as the underlying cause	40	63.5	100	48.3	41	26.3	181	42.5
Parkinson's disease mentioned but not the underlying cause	40	61.5	134	57.5	82	44.6	256	53.1
Total Mentions	80	62.5	234	53.2	123	36.2	437	48.1

Associations between causes of death: Individuals across all ages with Parkinson's disease listed on the death certificate are 2.93 times more likely to have dementia listed and 1.21 more likely to list stroke as a cause of death than if the diseases are independent (Table 5).

Table 5: Causes of death associated with Parkinson's disease for all ages and by age groups

Causes of Death Associated with Parkinson's	**Ratio observed to expected deaths**			
	All Ages	< 65	65-85	>85
Alzheimer's disease / dementia	2.93*	30.96*	3.20*	1.65*
Cerebrovascular disease (stroke)	1.21*	1.74	1.09	0.99
Essential hypertension	0.896	--	0.87	0.75
Diabetes	0.741*	1.92	0.68*	0.72
Chronic ischemic heart disease	0.671*	--	0.61*	0.70*
Congestive heart failure	0.644*	6.44*	0.52*	0.54*
Chronic obstructive pulmonary disease	0.540*	3.10	0.42*	0.58*
Peripheral vascular disease	0.517*	--	0.45*	0.49*
Renal failure	0.505*	--	0.43*	0.53*
Malignant neoplasms (cancer)	0.329*	0.39	0.30*	0.57*
Acute myocardial infarction	0.319*	--	0.27*	0.52*
Multiple Sclerosis	--	--	--	--

*χ^2 test for independence significant at p=.05.
Note: -- indicates no cases with both diseases listed.

Parkinson's is known to sometimes be mislabelled as dementia or Alzheimer's especially by family physicians treating the elderly. Also, the rates of Parkinson's disease, Alzheimer's disease and other dementia-related disorders increase dramatically with age especially over age 85 years. Therefore, they often coexist. However, aside from the possibility of a need to adjust for age within the 85 years and over age group, this does not explain the significant ratio of 1.65.

Furthermore and possibly more importantly, it does not explain the significantly high rate of association for persons under 65 years which was unexpected.

All other diseases analyzed show associations which are less than expected excluding essential hypertension which is not significantly significant suggesting Parkinson's and hypertension are independent. The lower than expected associations may relate to the concept of 'master status' which is reported in the sociological literature as a phenomenon where one disease can take precedence over other conditions in a clinician's review resulting in other diseases are not fully considered or reported.

The youngest age group shows half of the ratios are missing indicating there were no cases with Parkinson's and the selected disease listed together on the death certificate. This is likely due in part to the very small number of descendents in this age group with any mention of Parkinson's.

Alzheimer's/dementia consistently show an association which is greater than expected across age groups. Congestive heart failure is significant. However, the under 65 age group is greater than expected while the older age groups are smaller. Further analysis, for example by adding more years of data to this analysis, may help determine if this is an anomaly of the data.

End of Life Trajectories

A comprehensive literature review has not been carried out as yet to provide a context for these quantitative observations. However, the recent paper by Lanoix (2009) provides a pertinent synthesis contrasting a palliative care versus chronic disease approach for Parkinson's disease which provides a solid rationale for the need for further investigation into the provision of adequate care at end of life for persons with Parkinson's disease.

A classification of trajectories of dying helps foster dialogue on planning the end of life care needs for the majority of decedents. Trajectories were first described by Glaser and Strauss in 1968 (Lunney et al., 2002). Lunney et al. (2002 and 2003) refined this concept and developed four trajectory groups (Figure 2). "Sudden Death" includes those who died as a result of an accident or other external cause of mortality. The "Terminal Illness" category includes those who declined over a short period of time due to cancer, HIV-related diseases, motor neuron disease or chronic renal failure. "Organ Failure" includes those individuals with conditions such as CHF or COPD where functional status gradually declined with intermittent, serious exacerbations. The "Frailty" category includes those who experienced prolonged dwindling due to Alzheimer's disease, Parkinson's disease, other neurological conditions or late effects of stroke.

NELS ICE assigned all NS decedents from 2000 to 2005 to one of the four trajectory groups based on methods by Fassbender et al. (2006) that used the underlying cause of death (Figure 3). This shows that end of life care could be planned for 93-95% of all deaths in the province.

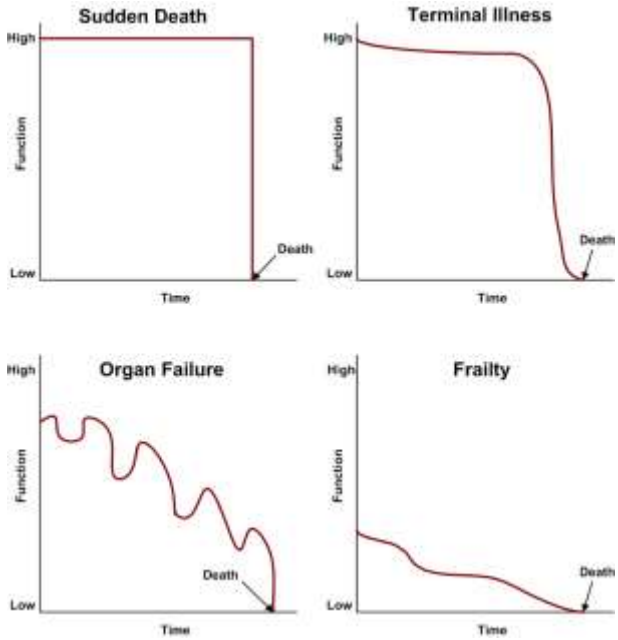

Figure 2: Trajectories of dying

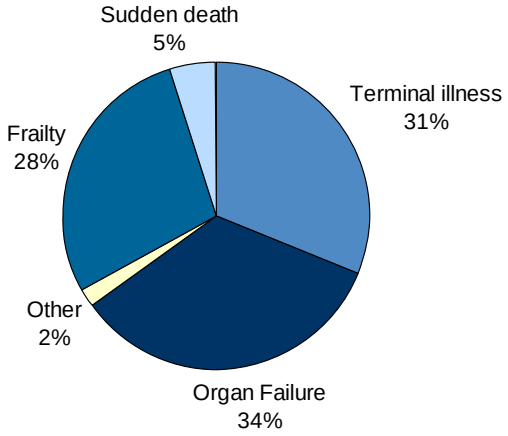

Figure 3: NS deaths by trajectory of dying, 2000-2005.

While the elderly with Parkinson's likely fit the Lunney et al "frailty" trajectory as indicated above, younger persons with Parkinson's might be more appropriately classified as organ failure. One example is that of Michael J Fox. Their disease can be hard to control and they are called "fluctuators". They takes high doses of medications to get Parkinson's under control, but the medications can lead to side effects and crises. These drugs are known to have nasty side effects, and most people require continuous escalation of dose to control symptoms. The newer, controlled release products are somewhat more easily tolerated, but we still do not have really 'good' treatments, i.e. without substantial adverse effects.

Concluding Comment

The overall purposes of preparing this report was to build research and surveillance capacity and to improve care for vulnerable populations. Discussion of these data will hopefully provide a forum for further development and exploration. Definitive conclusions cannot be reached from the data reported herein. However, hypotheses can be generated and issues requiring further study delineated.

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Appendix

Table A1: Selected chronic diseases and their corresponding International Classification of Diseases (ICD) codes.

Disease	**ICD-9 (1979-1999)**	**ICD-10 (2000-present)**
Parkinson's disease	332	G20-G21
Cancer	140-208	C00-C97
Alzheimer's disease and dementia	290, 331.0	F00-F03, G30
Chronic ischemic heart disease (excluding acute myocardial infarction)	412-414, 429.2	I20, I25
Acute myocardial infarction	410	I21
Cerebrovascular disease (stroke)	430-434, 436-438	I60-I69
Pneumonia	480-486	J12-J18
Chronic obstructive pulmonary disease (excluding asthma)	490-492, 496	J40-J44
Pneumonitis due to solids and liquids	507	J69
Injury, poisoning and certain other consequences of external causes External causes of morbidity and mortality	800-999 E800-E999	S00-T98 V01-Y98