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

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NELS | Network for End of Life Studies
ICE | Interdisciplinary Capacity Enchancement

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 (NSVS). This report focuses on **diabetes** 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. Refer to Appendix A for a diagram of proposed data linkages.

Purpose

The purposes of this report are to:
- share a synthesis of diabetes findings from an analysis of NSVS death certificate data;
- dialogue with persons interested in further building research and surveillance to improve care available to people at end of life with diabetes; and,
- examine disparities in health service use for populations at risk for reduced access to quality end of life care.

This report is being shared with you to explore ways to build research and surveillance capacity to help improve care for vulnerable populations. Historically, palliative care programs have been developed for the many numbers of persons dying relatively quickly of cancer each year. In recent years, there has been increasing interest in examining palliative and end of life care issues for persons dying of chronic conditions other than cancer.

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 Diabetes Deaths: Diabetes deaths among the 63,431 total deaths were identified with ICD cause of death codes. 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). The ICD-9 code for diabetes is 250 and the ICD-10 codes are E10-E14.

Multiple Causes of Death: There can be 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 diabetes, all records for which diabetes was mentioned as a cause of death on the death certificate were examined. This diabetes report uses methods similar to those in a report by Gorina and Lentzer (2008) who investigated multiple cause-of-death data in the United States for decedents over age 65. A paper by Romon et al. (2008) describes the burden of diabetes-related mortality in France using both the underlying and multiple causes of death.

Results

Deaths with Diabetes Mentioned or Selected as Underlying Cause: A total of 1,930 persons died with diabetes as their underlying cause of death from 1998 to 2005 in Nova Scotia. This is 3.0% of all Nova Scotia deaths. A further 4,986 persons had diabetes as a cause of death which was not selected as the underlying cause. Thus, a total of 6,916 persons had any mention of diabetes on their death certificate, which is 10.9% of all Nova Scotia deaths.

The percentage of total deaths from diabetes increased from 1998 to 2005 (Table 1). The rise in deaths from 717 and 721 in 1998 and 1999 respectively to nearly 850 in 2000 may be due to differences between ICD-9 and ICD-10. According to Statistics Canada (2005), there were 4.0% more deaths classified to diabetes deaths after the introduction of ICD-10.
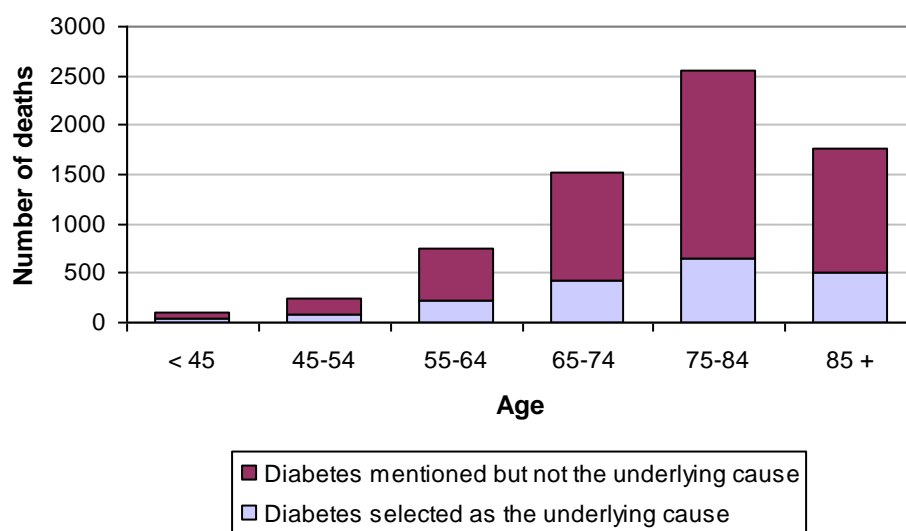
Table 1: Number of deaths with diabetes mentioned or selected as the underlying cause, by year of death, Nova Scotia, 1998-2005.

	1998	1999	2000	2001	2002	2003	2004	2005	Total
Diabetes selected as the underlying cause	178	178	262	232	273	285	257	265	1930
Diabetes mentioned but not the underlying cause	539	543	586	635	591	692	683	717	4986
Total Mentions (% of total deaths)	717 (9.0)	721 (9.5)	848 (10.8)	867 (11.1)	864 (10.9)	977 (12.2)	940 (11.5)	982 (12.0)	6916 (10.9)

Over 95% of diabetes deaths appear after age 45 (Table 2 and Figure 1). The mean age of decedents with an underlying cause of diabetes is 75.5 years while the mean age of decedents with any mention of diabetes is 76.2 years. Diabetes tends to be reported more often in males under age 85 but there are more deaths in females over age 85.

Table 2: Number of deaths with diabetes mentioned or selected as the underlying cause, by age and sex, Nova Scotia, 1998-2005.

Age Group	Diabetes selected as the underlying cause			Diabetes mentioned but not the underlying cause			Total Mentions		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
< 45	23	16	39	40	25	65	63	41	104
45-64	206	102	308	433	251	684	639	353	992
65-74	247	185	432	620	462	1082	867	647	1514
75-84	303	344	647	977	920	1897	1280	1264	2544
85 +	175	329	504	469	789	1258	644	1118	1762

Figure 1: Number of deaths with diabetes as the underlying cause and diabetes mentioned but not the underlying cause, by age, Nova Scotia, 1998-2005.

Non-Diabetes Causes of Death Mentioned for Persons with Diabetes as the Underlying Cause:
Nearly all of the 1,930 deaths with diabetes selected as the underlying cause had at least one cause of death other than diabetes (Table 3). The non-diabetes causes of death included diseases such as heart disease, renal failure and peripheral vascular disease. Since there could be up to 12 other causes of death beyond diabetes, an individual may be reported in more than one row of Table 3. For example, if a person had diabetes, hypertension, and renal failure on their death certificate, this person would be one of the 492 hypertension counts as well as one of the 523 renal failure counts. Refer to Appendix B for a listing of the ICD codes used.

Table 3: Number and percent of decedents with selected non-diabetes causes of death when diabetes was the underlying cause (n = 1,930), Nova Scotia, 1998-2005.

Non-Diabetes Cause of Death	N	%
Chronic ischemic heart disease	674	34.9
Renal failure	523	27.1
Essential hypertension	492	25.5
Cerebrovascular disease (stroke)	398	20.6
Acute myocardial infarction	349	18.1
Congestive heart failure	292	15.1
Peripheral vascular disease	287	14.9
Alzheimer's disease / dementia	186	9.6
Chronic obstructive pulmonary disease	137	7.1
Malignant neoplasms (cancer)	101	5.2
Total with ≥ 1 non-diabetes disease cause(s)[‡]	1911	99.0

[‡] Columns do not add up to the totals for this table because a diabetes decedent may have more than one non-diabetes cause of death mentioned. The total with ≥ 1 non-diabetes cause(s) is the total number of decedents having an underlying cause of diabetes and at least one non-diabetes cause mentioned on their death certificate.

Underlying Non-Diabetes Causes when Diabetes was Other Mentioned Cause: Among the 4,986 deaths where diabetes was mentioned but not given as the underlying cause, major non-diabetes underlying causes of death included cancer, heart disease and stroke (Table 4).

Table 4: Number and percent of decedents with selected non-diabetes underlying causes of death when diabetes was mentioned but not the underlying cause (n =4,986), Nova Scotia, 1998-2005.

Non-Diabetes Underlying Cause of Death	N	%
Malignant neoplasms (cancer)	1,006	20.2
Chronic ischemic heart disease	911	18.3
Acute myocardial infarction	691	13.9
Cardiovascular disease (stroke)	406	8.1
Chronic obstructive pulmonary disease	266	5.3
Alzheimer's disease / dementia	195	3.9
Congestive heart failure	147	2.9
Renal failure	106	2.1
Peripheral vascular disease	65	1.3
Essential hypertension	62	1.2
Other non-diabetes underlying causes	1,131	22.7
Total	4,986	100.0

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 NSVS, 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, 62.1% of all deaths where diabetes was mentioned on the death certificate occurred in-hospital (Table 5). The percentage dying in-hospital tends to decrease as age increases with 65.8% dying in-hospital among those under 65 years, and 49.1% dying in-hospital among those 85 years and over. Persons with diabetes as the underlying cause are less likely to die in-hospital (54.9%) than if diabetes is another mentioned cause of death (64.9%) overall, and within each age group.

Table 5: Number and percent of in-hospital deaths with diabetes mentioned or selected as the underlying cause, by age, Nova Scotia, 1998-2005.

Age Group	Diabetes selected as the underlying cause		Diabetes mentioned but not the underlying cause		Total Mentions	
	N	%	N	%	N	%
< 65	216	62.3	505	67.4	721	65.8
65-74	250	57.9	783	72.4	1033	68.2
75-84	398	61.5	1278	67.4	1676	65.9
85 +	195	38.7	670	53.3	865	49.1
Overall	1059	54.9	3236	64.9	4295	62.1

End of Life Trajectories: In addition to place of death, the events prior to death could also benefit from greater investigation. 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 diabetes, 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, 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.
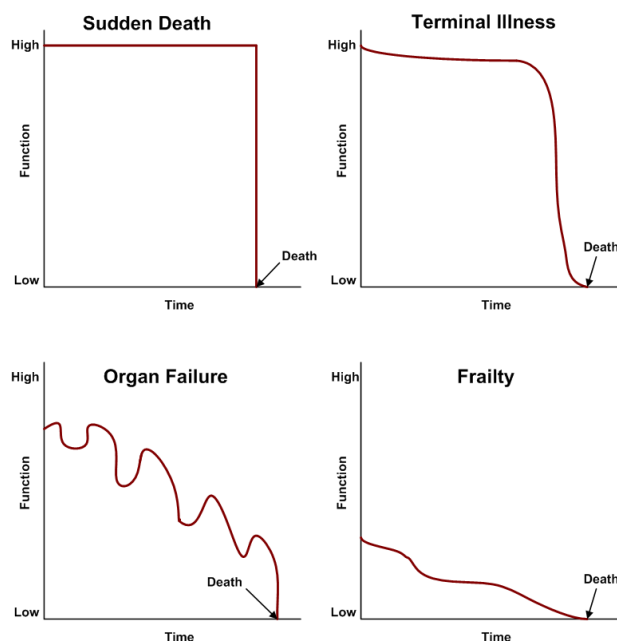
Figure 2: Trajectories of dying
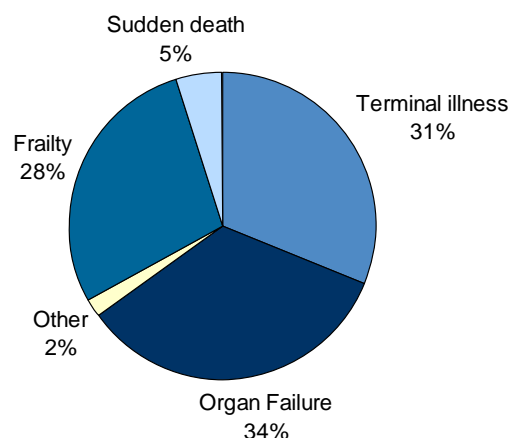
Figure 3: NS deaths by trajectory of dying, 2000-2005.

Next Steps

The following next steps are planned or are in progress:

1. *Compare the number of diabetes deaths captured by the National Diabetes Surveillance System (NDSS) for Nova Scotia with the number of diabetes deaths captured by NSVS.* NELS ICE researchers have previously compared the level of agreement of cause of death information between the Nova Scotia Cancer Registry and NSVS (Johnston, Burge, Boyd, & MacIntyre, 2001). A similar approach could be used for diabetes.

   Mortality statistics produced by DCPNS (Diabetes Care Program of Nova Scotia, 2008) are derived from the NDSS. The NDSS is a national network of provincial and territorial diabetes surveillance systems that was created to improve the information available on diabetes in Canada. Diabetes cases are identified by NDSS using the following criteria:
   - One or more hospitalization with an ICD-9 or ICD-9-CM code of 250 (diabetes mellitus) or equivalent ICD-10-CA codes: E10 to E14, selected from all available diagnostic codes in the hospital file,   OR
   - Two or more physician claims with the relevant ICD-9 code of 250 or diagnosis text within two years, selected from the first diagnosis code available on the claim. (National Diabetes Surveillance System, 2008)

   The definition of a diabetes-related death by NSVS is simply the documentation of diabetes by the attending physician or medical examiner on the Medical Certificate of Death section of the Death Registration form. A handbook on medical certification of death is available (Nova Scotia Vital Statistics, 2002).

2. *Further examine comorbidities at end of life*. NELS ICE continues to dialogue with provincial disease programs and supports the collaboration among these programs to better understand comorbidities.

3. *Include section on diabetes in NELS ICE 2011 Surveillance Report.* Alison Zwaagstra, NELS ICE Health Information Analyst, is planning another surveillance report summarizing the findings from the analysis of NSVS death certificate data. The primary focus of the 2011 report will be chronic disease causes of death other than cancer. Any support the Diabetes Care Program of Nova Scotia could provide with this project would be greatly appreciated.

4. *Learn from DCPNS project examining the factors contributing to time to comorbidities and time to death.* DCPNS is currently carrying out a project using data from their registry to better understand the burden of diabetes in NS. For this project, DCPNS has partnered with other provincial programs, the NS Department of Health and the Public Health Agency of Canada. Survival analysis methodology is being used to describe time to comorbidities and time to death. Factors being investigated include age, sex, geography (DHA, urban/rural), income, medication use, BMI, and smoking status. This project is scheduled to be completed in the spring of 2010. Pam Talbot, DCPNS project manager, has offered to present the project findings to NELS ICE at that time.

Conclusion

The intent of NELS ICE is to increase capacity for interdisciplinary research development to improve care at the end of life for vulnerable populations. The development of an expanded end of life dataset and the dissemination of findings from the analyses of these data is one aspect of this capacity development. You are being provided with this report with the hope that you and your colleagues may find these data of use and that you will be part of the data development process for palliative and end of life care.

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Appendix A

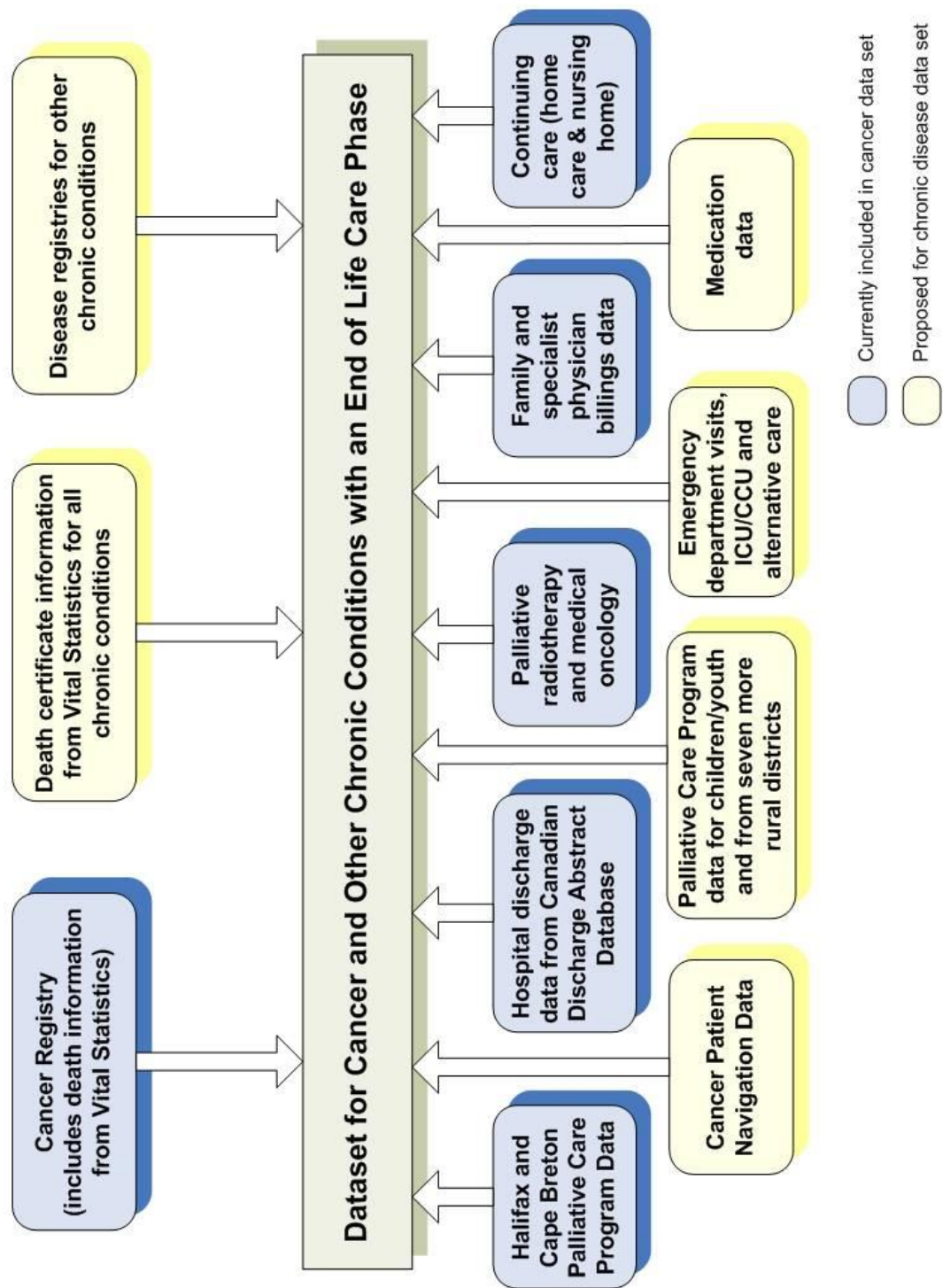**Figure A1:** Current and proposed NELS ICE data linkages.

Appendix B

Table B1: Selected chronic diseases and their corresponding International Classification of Diseases (ICD) codes.

Disease	ICD-9 (1979-1999)	ICD-10 (2000-present)
Diabetes mellitus	250	E10-E14
Cancer	140-208	C00-C97
Alzheimer's disease and dementia	290, 331.0	F00-F03, G30
Essential hypertension	401	I10
Chronic ischemic heart disease (excluding acute myocardial infarction)	412-414, 429.2	I20, I25
Acute myocardial infarction	410	I21-I22
Congestive heart failure	428.0	I50.0
Cerebrovascular disease (stroke)	430-434, 436-438	I60-I69
Peripheral vascular disease (includes atherosclerosis)	440-444	I70-I74
Chronic obstructive pulmonary disease (excluding asthma)	490-492, 496	J40-J44
Renal failure	584-586	N17-N19