Centre for Health Information
Newfoundland & Labrador

ENHANCING CHRONIC DISEASE SURVEILLANCE IN NEWFOUNDLAND AND LABRADOR: ADJUSTMENT OF RATES BASED ON PHYSICIAN PAYMENT METHOD

Research and Evaluation Department

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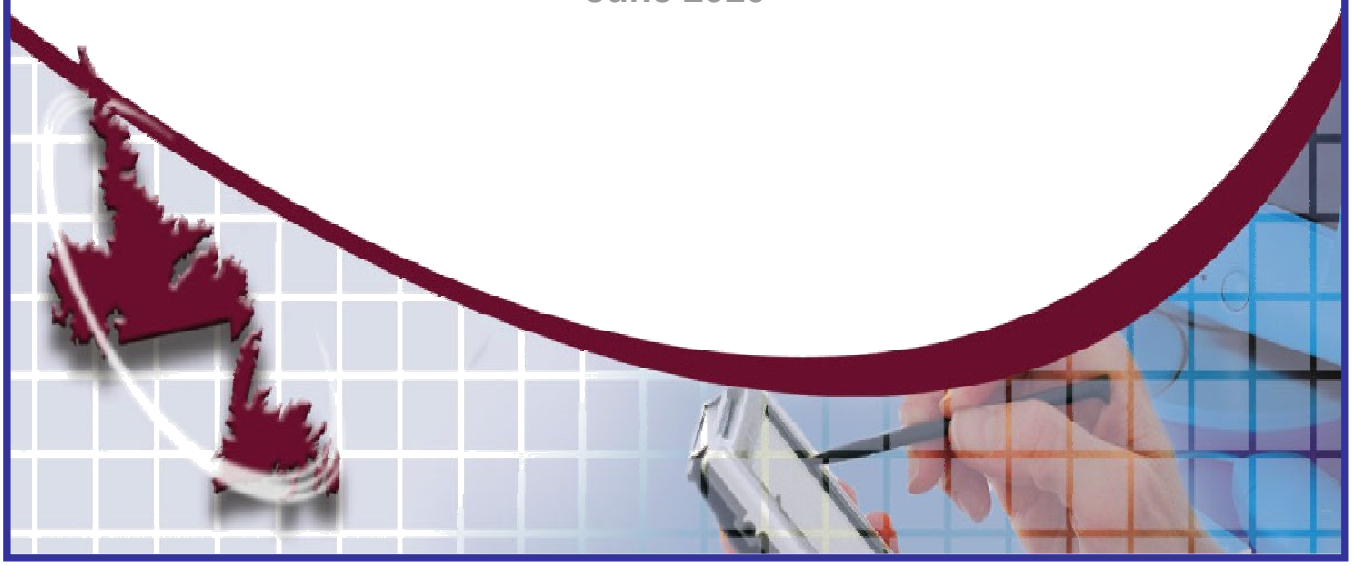

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INTRODUCTION

Diabetes is a disease that carries with it a significant health burden and financial cost. There are currently more than two million Canadians living with diabetes, and it is expected that this number will rise to three million by 2010.[1] In addition to the acute complications associated with diabetes such as hyperosmolar nonketotic coma and diabetic ketoacidosis,[2] people with diabetes are at an increased risk for certain serious, long term health conditions such as cardiovascular disease (CVD), kidney disease, and blindness. People with diabetes also have an increased risk of death from infections such as pneumonia and influenza.[3]

The Canadian Chronic Disease Surveillance System (CCDSS), formerly the National Diabetes Surveillance System (NDSS), was developed in 1997 in an effort to improve diabetes surveillance in Canada.[4] The first report of the CCDSS was released in 2003[4] and, since then, additional reports have been released in 2004-2005, 2008, and 2009.

The CCDSS utilizes three provincial databases that contain personally identifiable information. These databases are used within each province and territory to produce provincial-level data on diabetes and associated co-morbidities. Anonymous, aggregate data is subsequently sent to the Public Health Agency of Canada (PHAC) for national reporting. The databases used in the CCDSS include the physicians claims file, the hospital file, and the health insurance registry file within each province. The physician claims file contains information submitted by fee-for-service physicians and includes diagnostic information used in diabetes case-ascertainment. The hospital discharge database contains diagnostic information recorded when a patient is discharged from hospital and is also used for diabetes case-ascertainment. These two databases provide the number of diabetes cases for the calculation of rates. The health insurance registry file provides population data for the calculation of rates and includes information on place of residence, date of birth, and sex. The CCDSS uses a validated case definition to identify an individual as having diabetes. An individual is identified as a diabetes case if they have one hospitalization with a diagnosis of diabetes, or two physician claims with a diagnosis of diabetes, within 730 days.[4]

While the physician claims file includes information on services provided by fee-for-service physicians only, some jurisdictions employ shadow billing which requires physicians paid by alternate methods (i.e. salaried or other) to submit service information, regardless of their payment method.[4] As Newfoundland and Labrador does not require physicians paid by alternate methods (which is largely by salary) to submit service information, records of visits to physicians paid via alternate payment schemes are not captured by the Newfoundland and Labrador component of the CCDSS. According to the Newfoundland and Labrador Medical Care Plan (MCP), as of September 30, 2009, approximately 65% of the practicing physicians in Newfoundland and Labrador were being paid by the fee-for-service payment method, the majority of which practice in urban areas of the province.[5]

The high number of salaried physicians practicing within Newfoundland and Labrador, combined with the fact that shadow billing is not used in the province, makes it likely that diabetes prevalence and incidence figures produced by the Newfoundland and Labrador component of CCDSS are underestimates, particularly in rural areas of the province. The purpose of this project was to develop a model to adjust data obtained from the CCDSS based on the distribution of physicians that practice within Newfoundland and

Labrador by payment method and use the model to better reflect the true estimates of diabetes in Newfoundland and Labrador. This model may then be used to adjust incidence and prevalence for any disease or condition included in the CCDSS.

ETHICAL CONSIDERATIONS

As the nature of this project is related to enhancing capacity for chronic disease surveillance rather than research, approval from a Research Ethics Board (REB) was not required. All data used for this project was securely stored at the Newfoundland and Labrador Centre for Health Information (the Centre for Health Information) according to privacy and security policies.

DATA SOURCES

Sources of data used in this project included:

A. Diabetes incidence and prevalence data obtained from the Newfoundland and Labrador component of the Canadian Chronic Disease Surveillance System (CCDSS) for 2006/07 (maintained by the Centre for Health Information).

B. Data relating to the geographical distribution of fee-for-service and salaried physicians in the province, as of September 30, 2009 (obtained from the provincial Department of Health and Community Services).

MODEL

Incidence

The number and ratio of fee-for-service versus salaried physicians was determined for each Regional Health Authority (RHA) within Newfoundland and Labrador using data relating to the distribution of physicians by payment method. Using data obtained from the CCDSS, the number of individuals who met the diabetes case definition through a hospital diagnosis, a diagnosis from a fee-for-service physician visit (i.e. medical claim) or both was also determined for each RHA. It was important to consider different geographical areas of the province separately as the ratio of fee-for-service to salaried physicians differed significantly between regions and it is likely that the proportion of cases diagnosed by salaried physicians is not consistent throughout Newfoundland and Labrador. Physicians paid by alternate methods other than salary (n = 40) were excluded from this analysis as the number of diabetes diagnoses made by these physicians (e.g. anesthetist, cardiac surgeon, obstetrician) is likely to be low.

The number of new cases of diabetes in 2006/07 for each RHA was determined based on their place of residence. A breakdown of the number of new cases by source of case ascertainment was available in the CCDSS, making it possible to determine the number and percentage of new cases ascertained through fee-for-service physician visits, hospital discharge, or both hospital discharge and fee-for-service physician visits, for each RHA.

The number of new diabetes cases identified through physician claims was adjusted using the ratio of fee-for-service to salaried physicians for each RHA as follows:

The four health regions (RHAs) were denoted by $i = 1,2,3,4$ and represented the Eastern, Central, Western and Labrador/Grenfell RHAs, respectively.

The estimated number of new diabetes cases diagnosed by salaried physicians in the i^{th} RHA $\left(d_i^s\right)$ was defined as

$$d_i^s = \left(\frac{d_i^f}{F_i}\right) \times S_i ,$$

where d_i^f is the number of diagnosed diabetes cases by fee-for-service physicians, F_i is the number of fee-for-service physicians and S_i is the number of salaried physicians in i^{th} RHA.

Following the derivation of d_i^s, an adjusted number of new cases of diagnosed diabetes by all physicians in the i^{th} RHA $\left(d_i^p\right)$ was estimated as

$$d_i^p = d_i^f + d_i^s .$$

The total number of cases of diagnosed diabetes in a health region $\left(d_i\right)$ was then calculated by adding the number of cases diagnosed by physicians only $\left(d_i^p\right)$, hospitalizations only $\left(d_i^h\right)$, and both hospitalization and medical claims $\left(d_i^b\right)$:

$$d_i = d_i^p + d_i^h + d_i^b$$

The total number of new cases of diabetes for the province can then be calculated as:

$$d = \sum_{i=1}^{4} d_i .$$

Prevalence

As CCDSS data do not allow for a breakdown of prevalence data by the source from which the case was ascertained (i.e. a person may be identified as having diabetes from hospital data in a particular year and later show up in the medical claims database), it was assumed that the proportion of patients meeting the case-definition by hospitalization, fee-for-service physician visit or both would be similar for the incidence and prevalence of diabetes. As such, prevalence data were broken down by data source

from which the case-definition was met according to the corresponding percentages for incidence.

If d_i^f is the number of new cases diagnosed by fee-for-service physicians out of the total number of new cases (d_i) in the i^{th} RHA, the number of existing cases diagnosed by fee-for-service physicians in each RHA is estimated as $D_i^f = \frac{d_i^f}{d_i} \times D_i$, where D_i is the total number of existing cases of diabetes in the i^{th} RHA.

The number of existing diabetes cases identified through physician claims were then adjusted as follows:

The estimated number of diabetes cases diagnosed by salaried physicians in the i^{th} RHA $\left(D_i^s\right)$ was defined as

$$D_i^s = \left(\frac{D_i^f}{F_i}\right) \times S_i,$$

where D_i^f is the number of diagnosed diabetes cases by fee-for-service physicians, F_i is the number of fee-for-service physicians and S_i is the number of salaried physicians in the i^{th} RHA. As with incidence, physicians paid by alternate methods other than salary were not included in the adjustment.

Following the derivation of D_i^s, an adjusted number of existing cases of diagnosed diabetes by all physicians in the i^{th} RHA $\left(D_i^p\right)$ was estimated as

$$D_i^p = D_i^f + D_i^s.$$

The total number of existing cases of diagnosed diabetes in a health region (D_i) was then calculated by adding the number of cases diagnosed by physicians $\left(D_i^p\right)$, hospitalization $\left(D_i^h\right)$, and both hospitalization and medical claims $\left(D_i^b\right)$:

$$D_i = D_i^p + D_i^h + D_i^b$$

The total number of existing cases of diabetes for the province can then be calculated as:

$$D = \sum_{i=1}^{4} D_i.$$

Following development of the model, it was used to adjust 2006/07 diabetes incidence and prevalence obtained from the Newfoundland and Labrador component of the CCDSS.

ADJUSTED RATES

There were 647 fee-for-service and 355 salaried physicians practicing in Newfoundland and Labrador as of September 30, 2009, for a total of 1002 physicians. This represents a 54.9% increase in the number of physicians being considered in the analysis, compared to the CCDSS which includes fee-for-service physicians only ($n = 647$). Presented in Table 1 is a breakdown of physicians within each RHA by payment method. With the exception of Labrador/Grenfell, fee-for-service physicians outnumbered salaried physicians in all RHAs. The ratio of fee-for-service to salaried physicians ranged from 1:6.9 in Labrador/Grenfell to 2.3: 1 in Eastern; the overall ratio was 1.8: 1.

Table 1. Payment method of physicians in Newfoundland and Labrador by RHA[1]

RHA	Fee-For-Service (F_i)	Salaried (S_i)	% Increase	Fee-For-Service: Salaried Ratio
Eastern	471	207	43.9	2.3: 1
Central	87	51	58.6	1.7: 1
Western	82	49	59.8	1.7: 1
Labrador/Grenfell	7	48	685.7	1: 6.9
Total	647	355	54.9	1.8: 1

[1]As of September 30, 2009

Incidence

The number of new (i.e. incident) diabetes cases for 2006/07 by source of case ascertainment is presented in Table 2. The total number of newly diagnosed cases was 4217, for an incidence of 9.0 per 1000 population (Appendix A). The percentage of diabetes cases diagnosed by a medical claim, hospital discharge, or both were relatively consistent across RHAs, with the exception of Labrador/Grenfell which had a greater proportion of cases diagnosed through hospitalization.

Table 2. Number and Percentage of new cases meeting case definition by source of case ascertainment and RHA, 2006/07

RHA	Source of data for diabetes case			Total
	Hospital	Medical Claim	Hospital and Medical Claim	
	N (%)	N (%)	N (%)	N (%)
Eastern	407 (19.1)	1608 (75.6)	111 (5.2)	2126 (100.0)
Central	197 (17.2)	884 (77.3)	62 (5.4)	1143 (100.0)
Western	147 (20.0)	545 (74.0)	44 (6.0)	736 (100.0)
Labrador/Grenfell	131 (61.8)	69 (32.5)	12 (5.7)	212 (100.0)
Total	882 (20.9)	3106 (73.7)	229 (5.4)	4217 (100.0)

Using the model developed to adjust for distribution of physicians by payment method, the adjusted number of new diabetes cases, including the estimated number of cases diagnosed by salaried physicians, was 6241(Table 3); this represents a 48% increase in new cases. As a result, the adjusted incidence of diabetes in Newfoundland and Labrador increased from 9.0 to 13.7 per 1000 population (Appendix A).

Table 3. Adjusted number of new cases of diabetes by RHA, 2006/07

RHA	Diagnoses by Fee-For-Service Physicians (d_i^f)	Estimated Diagnoses by Salaried Physicians (d_i^s)	Diagnoses by Hospital or Both $(d_i^h + d_i^b)$	Total (d_i)	Percent Increase (%)
Eastern	1608	707	518	2833	33.3
Central	884	518	259	1661	45.3
Western	545	326	191	1062	44.3
Labrador/Grenfell	69	473	143	685	223.1
Total	3106	2024	1111	6241	48.0

Using the Eastern RHA as an example, the estimated number of new cases of diabetes diagnosed by salaried physicians in Eastern was calculated by first determining the number of cases captured by each fee-for-service physician:

$$\left(\frac{d_1^f}{F_1}\right) = \left(\frac{1608}{471}\right) = 3.41 \qquad [i = 1 \text{ for Eastern RHA}]$$

This number was then multiplied by the number of salaried physicians in the region (S_i) to determine the estimated number of diabetes cases diagnosed by salaried physicians (d_i^s) :

$$d_1^s = 3.41 \times S_1 = 3.41 \times 207 = 707$$

The total number of individuals diagnosed by physicians (d_i^p) was then determined by adding the number of cases of diabetes diagnosed by fee-for-service (d_i^f) and salaried (d_i^s) physicians:

$$d_1^p = d_1^f + d_1^s = 1608 + 707 = 2315$$

The total adjusted number of cases of diabetes (d_i) was determined by adding the number of cases of diabetes diagnosed by physicians (d_i^p), by hospital discharges (d_i^h), and by both a hospital discharge and a medical claim (d_i^b):

$$\mathrm{d}_1 = d_1^p + d_1^h + d_1^b = 2315 + 518 = 2833$$

Finally, the total adjusted number of new cases of diabetes for the province was calculated by adding the total adjusted number of cases in each RHA:

$$d = \sum_{i=1}^{4} d_1$$
$$= 2833 + 1661 + 1062 + 685$$
$$= 6241$$

Unadjusted and adjusted diabetes incidence for the Newfoundland and Labrador is presented in Appendix A.

Prevalence

Table 4 presents the estimated number of existing (i.e. prevalent) cases meeting the case definition by source of case ascertainment. As previously noted, estimates are based on percentages calculated for incidence for each RHA. As of 2006/07, there were 38,616 existing cases of diabetes in the province, for a diabetes prevalence of 7.6% among individuals aged 1 year or older (Appendix A). As RHA was unknown for 304 cases, they were distributed among the four RHAs based on the proportion of existing cases in each RHA. For example, 57% of existing cases in the province were in Eastern, so 57% or 173 of the 304 unknown cases were assigned to that RHA.

As shown in Table 4, the estimated number of existing cases for 2006/07 diagnosed by fee-for-service physicians was 28590, derived from the actual total prevalence for the province as well as the distribution of new cases by source of case ascertainment (i.e. medical claim, hospitalization, or both).

Table 4. Number and percentage of existing diabetes cases meeting case-definition by source of case ascertainment and RHA, 2006/07

	Source of data for diabetes case[1]			Total
RHA	Hospitalization Only	Medical Claim Only	Hospital and Medical Claim	
	N (%)	N (%)	N (%)	N (%)
Eastern	4218 (19.1)	16664 (75.6)	1150 (5.2)	22032 (100.0)
Central	1482 (17.2)	6648 (77.3)	466 (5.4)	8596 (100.0)
Western	1289 (20.0)	4779 (74.0)	386 (6.0)	6454 (100.0)
Labrador/Grenfell	948 (61.8)	499 (32.5)	87 (5.7)	1534 (100.0)
Province	7937 (20.9)	28590 (73.7)	2089 (5.4)	38616 (100.0)

[1]Based on distribution of new cases by source of case ascertainment

Using the proposed model, the total adjusted number of existing cases in 2006/07 was 56115, an increase of approximately 45% (Table 5). As a result, the adjusted prevalence of diabetes in Newfoundland and Labrador changed from 7.6% to 11.1% (Appendix A).

Table 5. Adjusted prevalence of diabetes by RHA, 2006/07

RHA	Est. # of Diagnosis by Fee-For-Service Physicians $\left(D_i^f\right)$	Est. # Diagnosed by Hospitalization or Both $\left(D_i^h + D_i^b\right)$	Est. # of Diagnoses by Salaried Physicians $\left(D_i^S\right)$	Total $\left(D_i\right)$	Percent Increase (%)
Eastern	16664	5368	7324	29356	33.2
Central	6648	1948	3897	12493	45.3
Western	4779	1675	2856	9310	44.3
Labrador/Grenfell	499	1035	3422	4956	223.1
Total	28590	10026	17499	56115	45.3

Using the Eastern RHA as an example, the estimated number of existing cases of diabetes diagnosed by salaried physicians was calculated by first determining the number of cases of diabetes per fee-for-service physician by dividing the estimated number of cases captured through a visit to a fee-for-service physician by the number of fee-for-service physicians in the region:

$$\left(\frac{D_1^f}{F_1}\right) = \left(\frac{16664}{471}\right) = 35.38$$

This was multiplied by the number of salaried physicians in the region $\left(S_i\right)$ to estimate the number of diabetes cases diagnosed by salaried physicians $\left(D_i^s\right)$:

$$D_1^s = 35.4 \times S_1 = 35.38 \times 207 = 7324$$

The number of existing cases of diabetes diagnosed by physicians $\left(D_i^p\right)$ was then determined by adding the number of cases of diabetes diagnosed by fee-for-service $\left(D_i^f\right)$ and salaried $\left(D_i^s\right)$ physicians:

$$D_1^p = D_1^f + D_1^s = 16664 + 7324 = 23988$$

The total estimated number of existing diabetes cases $\left(D_i\right)$ was determined by adding the number of cases of diabetes diagnosed by physicians $\left(D_i^p\right)$, hospital discharges $\left(D_i^h\right)$, and by both a hospital discharge and a medical claim $\left(D_i^b\right)$:

$$D_1 = D_1^p + D_1^h + D_1^b = 23988 + 5368 = 29356$$

Finally, the total adjusted number of existing cases of diabetes for the province was calculated by adding the total adjusted number of cases in each RHA:

$$\begin{aligned} D &= \sum_{i=1}^{4} D_i \\ &= 29356 + 12493 + 9310 + 4956 \\ &= 56115 \end{aligned}$$

DISCUSSION

While the Canadian Chronic Disease Surveillance System (CCDSS) provides useful information about the prevalence and incidence of diabetes in Canada, the lack of data from physicians paid by alternate methods means that rates are almost certainly lower than true prevalence and incidence in the population. This is unavoidable when using administrative databases for research and surveillance purposes in Newfoundland and Labrador (NL) and many other jurisdictions as information from physicians paid by alternate methods, particularly salaried physicians, is often unavailable. In this project, a model was developed to adjust NL incidence and prevalence data extracted from the CCDSS, based on the distribution of physicians practicing within NL by payment method.

Prior to adjustment, the number of new and existing cases of diabetes in Newfoundland and Labrador in 2006/07 were 4217 and 38616, respectively. After using the model to adjust for physician payment method, the number of new and existing diabetes cases increased to 6241 and 56115, respectively. This represents an increase of 48% for incidence and 45% for prevalence. As a result of this increase, the incidence rate of diabetes in the province increased from 9.0 to 13.7 per 1000 population; prevalence increased from 7.6% to 11.1%. These adjusted estimates reflect the fact that there are a significant number of cases of diabetes diagnosed by salaried physicians that are not captured by the CCDSS. These numbers are likely closer to the true incidence and prevalence of diabetes in the province, as 35% of the physicians who practice in Newfoundland and Labrador are paid by salary, with no shadow billing.

The inclusion of salaried physicians in the analysis resulted in an increase in the number of physicians by 55%, compared to the CCDSS which includes fee-for-service physicians only. However, the model was used to adjust the number of cases diagnosed by fee-for-service physicians only, a subset of the total number of cases. That is, we adjusted 73.7% of new cases (3106 new cases diagnosed by fee-for-service physicians out of a total of 4217) and 74.0% of existing cases (28590 existing cases diagnosed by fee-for-service physicians out of a total of 38616). In addition, a small proportion of the Newfoundland and Labrador population is being served by a large proportion of salaried physicians, given that the majority of salaried physicians are practicing in rural areas where the population sizes are relatively small. As such, we would expect the increase of new and existing cases of diabetes to be less than 55%. The observed increases of 48% for incidence and 45% for prevalence are consistent with this expectation.

Due to the fact that incidence and prevalence data by RHA was either available or could be estimated, adjustment of the number of new and existing cases by health authority was possible. This produced a more accurate estimate than would have been obtained using total provincial numbers, as the ratio of fee-for-service to salaried physicians differed between RHAs.

The ratio of fee-for-service to salaried physicians is most notable for the Labrador-Grenfell region. Labrador/Grenfell has nearly seven times as many salaried physicians compared to fee-for-service physicians. In addition, a significant proportion of the inhabitants of Labrador are Aboriginal, a population with an estimated diabetes prevalence as high as three times the national average.[6] This may justify the large increase observed in the adjusted number of new and existing diabetes cases in the Labrador/Grenfell RHA. When only the Eastern, Central, and Western RHAs are

considered, the percentage increase in the incidence and prevalence of diabetes is 38.7% and 38.0%, respectively, which is much lower than when Labrador/Grenfell is included.

There were several assumptions that had to be made in developing this model. First, prevalence data could not be broken down by source of case ascertainment. As a result, the distribution of patients by source of case ascertainment was assumed to be the same for incidence and prevalence in a given year. This same assumption was then applied to the breakdown by RHA to obtain the estimated number of cases meeting the case definition through medical claims within each RHA. In addition, data on new cases could not be broken down by physician specialty, thus an adjustment for the ratio of GPs to specialists could not incorporated into the model. This would likely have had an impact as rates of diabetes diagnosis differ between GPs and specialists, with GPs having a higher rate of diagnosis.[7]

Given that the model developed for this study was based on a number of assumptions as discussed above, it is important that the model be validated. This could be achieved by carrying out a chart review for salaried physicians in an area of the province where the ratio of fee-for-service physicians is known and comparing findings to that obtained from the CCDSS using the adjustment model. If similar results are obtained from the validation study, this would provide evidence to support use of the model developed in this study. If results of the validation study differ significantly, this would provide evidence to revisit and refine the model. Further refinements to this model could be achieved by obtaining physician payment method data and number of new and existing cases of diabetes by source of case ascertainment for smaller geographical areas. As well, this model's accuracy could be improved by incorporating other methods such as capture-recapture.

Conclusion

In this project, we developed a model to adjust diabetes incidence and prevalence obtained from the CCDSS in Newfoundland and Labrador. As the CCDSS contains information on several chronic diseases other than diabetes, this model could also be used to adjust the incidence and prevalence of other conditions. Using this model, rates of diabetes were adjusted, resulting in a 48% increase in incidence and a 45% increase in prevalence. The observed increase was consistent with our expectations. It is recommended that a study be carried out to validate the model before using it to adjust incidence and prevalence data obtained from the CCDSS. Once the model is validated, it can be adapted for use in other jurisdictions. Finally, the model may be refined by including additional data related to physician type and by combining with other methods such as capture-recapture.

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Appendix A

Table A1. Unadjusted and adjusted incidence and prevalence of diabetes, 2006-2007

		Unadjusted	Adjusted
Incidence	Count	4217	6241
	Denominator	471099[1]	455624[2]
	Incidence Rate (per 1000)	9.0	13.2
Prevalence	Count	38616	56115
	Denominator	505498[3]	505498[3]
	Prevalence Percentage	7.6%	11.1%

[1] Population of NL – (# prevalent cases of diabetes in NL 2006/07 - # incident cases of diabetes in NL 2006/07)

[2] Population of NL – (adjusted # prevalent cases of diabetes in NL 2006/07 - adjusted # Incident cases of diabetes in NL 2006/07)

[3] Population of NL aged 1+

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