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Validity of Canadian Discharge Abstract Data for Hypertension and Diabetes from 2002 to 2013

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	subgroups by age, sex, or hospital location. Conclusion DAD validity for hypertension and diabetes remained fairly consistent between 2002 and 2013. Our findings support the use of DAD for hypertension and diabetes surveillance in hospital settings.

Validity of Canadian Discharge Abstract Data for Hypertension and Diabetes from 2002 to 2013

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Abstract

Background

Surveillance using coded administrative health data has shown that the prevalence of hypertension and diabetes in Canada has increased significantly in the last 10 years. These findings requires an assumption that the data validity for hypertension and diabetes coding is stable over time. We tested this assumption by examining the temporal trends of the Canadian hospital discharge abstract data (DAD) in the validity of hypertension and diabetes.

Methods

Using a clinical registry database of the Alberta Provincial Project for Outcome Assessment in Coronary Heart Disease (APPROACH) as a reference standard, we evaluated DAD validity in recording hypertension and diabetes in Alberta. APPROACH contains data on all Alberta residents who have received cardiac catheterization, and includes prospective ascertainment of comorbidities prior to each procedure. We linked DAD and APPROACH between 2002 and 2013. Temporal trends in sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were calculated for both hypertension and diabetes in the DAD.

Results

We matched 63,483 patients between the DAD and APPROACH. The validity of DAD for hypertension and diabetes remained mostly consistent over time. Sensitivity, specificity, PPV and NPV ranged from 61% to 87% for hypertension and 81% to 98% for diabetes, between 2002 and 2013. No significant differences in the validity of codes were found across subgroups by age, sex, or hospital location.

Conclusion

DAD validity for hypertension and diabetes remained fairly consistent between 2002 and 2013. Our findings support the use of DAD for hypertension and diabetes surveillance in hospital settings.

Introduction

Surveillance of chronic diseases has been established in many countries for monitoring disease burden and evaluating prevention and therapeutic programs. Temporal trends in disease prevalence are also used to forecast population health status and health resource needs. These trends inform health care policy such as resource allocation. The Public Health Agency of Canada (PHAC) created the Canadian Chronic Disease Surveillance System (CCDSS) to provide governments and the public with new knowledge in order to inform efforts to reduce the risk of developing chronic conditions [1]. Collaborating with provincial and territorial health ministries, the system has successfully tracked hypertension and diabetes using administrative health data. According to CCDSS, from 1998 to 2008, hypertension prevalence in Canada increased from 12.5% to 19.6%; diabetes prevalence from 3.3% to 5.4% [2,3]. The rate of increasing prevalence is alarming and has raised important health policy and chronic disease prevention questions. However, before interpreting these temporal trends in disease prevalence, potential errors from surveillance methods must be excluded or adjusted for.

A major question that remains unexamined is whether data validity has remained consistent over the time period of this surveillance program. While improving data quality over time is generally a good thing, it could be problematic for interpreting temporal trends in disease surveillance. For example, improving sensitivity of disease detection over time will result in increases in prevalence estimates that exceed those in reality. The CCDSS monitors disease burden using diagnostic codes from the hospital discharge abstract database (DAD) and the physician claims database [1]. DAD contains information on all admissions at acute care facilities and physician claims captures billing data from physician visits. DAD and physician claims are attractive sources for disease surveillance because both readily available, and cover large populations of Canada [4].

To assess if the above question has been addressed, we reviewed the literature. The published studies assessed a relatively short time period, usually only conducting two or three comparisons over a maximum of five years [5-14]. To fill this gap, we conducted this study to examine the validity of administrative codes from the DAD for hypertension and diabetes from 2002 to 2013. A prospective clinical registry, the Alberta Provincial Project for Outcome Assessment in Coronary Heart Disease (APPROACH) database, was used as the reference standard. Our hypothesis is that hypertension and diabetes have been coded with increasing accuracy over time; contributing to their apparent rapid increase of prevalence in CCDSS.

Methods

Data Sources: DAD and APPROACH

DAD contains information on all inpatient discharges in Alberta. After the patient is discharged, professional coders translate the diagnosis on medical charts into International Classification of Diseases (ICD) codes [15]. These ICD codes are then recorded in DAD, and used (eg. by CCDSS) in the calculation of chronic disease prevalence. Coders are primarily instructed to code conditions contributing to the hospitalization [16]. In Alberta, up to 50 conditions can be recorded using ICD-10 for each admission.

The APPROACH database is a prospective clinical registry that records detailed clinical information, including comorbidities, on patients undergoing coronary catheterization in Alberta since 1995. Comorbidity data is collected directly by clinicians and catheterization laboratory staff prior to each procedure [17]. The fact that patient information is collected prospectively in the clinical setting provides three major advantages. First, data collection follows a fixed structure and format. APPROACH contains a required form asking clinicians to enter information for a fixed set of comorbidities, whereas in DAD, coders are free to enter information on as many or as few conditions as they see fit. Second, the direct collection of data in the clinical setting reduces the chance of error due to data translation in APPROACH, whereas the DAD coders must collect and interpret information from medical charts that were written by clinicians. Third, APPROACH contains routine processes that check for data quality and completeness. Further, procedures are in place to continuously standardize and improve measurement and capture of comorbidities. These attributes of APPROACH make it an ideal choice for our reference standard.

Patient data from APPROACH were linked with DAD from 2002 to 2013 using the unique identifier of provincial health number (PHN). The data unit for APPROACH is patients, but in DAD it is admissions. Thus one APPROACH patient could be linked with multiple admissions. To avoid this, we selected a single index admission from DAD for each linked patient. For the index admission, we chose the admission where the catheterization date falls in between the admission and discharge date.

Study Variables

In DAD hypertension was defined using the ICD-10 codes: I10.x, I11.x-I13.x, I15.x. Diabetes was defined using the ICD-10 codes: E10.x, E13.10, E13.12, E14.10, E14.12, E11.x, E13.0, E14.0. Hyperlipidemia, heart failure, cerebrovascular disease, peripheral vascular disease (PVD) and chronic obstructive pulmonary disease (COPD) were assessed as possible confounding comorbidities, and were defined using previously validated codes [18].

In APPROACH, clinicians diagnose presence or absence of these conditions at the time of catheterization following clinical guidelines and practice. Information on age, sex, and hospital location was obtained from APPROACH.

Data Analysis

Descriptive statistics were employed to describe study populations. Hypertension and diabetes prevalence differences between 2002 and 2013 for both APPROACH and DAD were calculated, along with a 95% confidence interval. Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) for DAD recording of hypertension and diabetes were calculated for each year using APPROACH as the reference standard. These estimates were then stratified by age, sex, and hospital location to assess whether these factors significantly affected study outcomes.

Results

Of 63,483 patients who were linked between DAD and APPROACH, 70.5% were male and the average age was 62.6 years in 2013 (Table 1). The prevalence of hypertension was 57.8% in DAD and 57.4% in APPROACH and prevalence of diabetes was 23.6% in DAD and 26.0% in APPROACH in 2013 (Table 2). For both hypertension and diabetes, the prevalence was similar for DAD and APPROACH, respectively across age, sex and hospital location over the entire study period (Figure 1; Table 2). There was no statistically significant change or very minor changes in disease prevalence over time in both APPROACH and DAD (Table 2).

The validity of DAD coding for hypertension and diabetes, using APPROACH as a reference standard, also remained consistent over time (Figure 2). For hypertension, overall sensitivity ranged from 74.6% to 82.5%, specificity ranged from 71.0% to 80.9%, PPV ranged from 79.3% to 87.0% and NPV ranged from 65.5% to 78.0% (Table 3). When looking at the overall trend, the validity of hypertension coding in DAD remained mostly consistent from 2002 to 2013.

Validity of DAD coding of diabetes was also high (Table 3). Overall sensitivity ranged from 83.8% to 92.1%, specificity ranged from 93.9% to 97.0%, PPV ranged from 81.5% to 90.5%, and NPV ranged from 94.5% to 97.6%. Similar to the results for hypertension coding, the overall trend of diabetes coding in DAD was mostly consistent from 2002 to 2013.

The validation trends for hypertension and diabetes coding were stratified by age, sex, and hospital location. There were no significant differences in regards to validation trends for either hypertension or diabetes, between those aged 18-64 compared with those aged 65 and up, or between males and females, or between Calgary and Edmonton hospitals (these results were not reported here).

Interpretation

We examined the performance of DAD coding for hypertension and diabetes between 2002 and 2013 to determine whether changes have occurred in diagnostic coding validity over time, because such changes could influence the chronic disease surveillance estimates of these two common conditions. Our study leads to three main findings: 1) hypertension and diabetes coding in the DAD provided similar prevalence estimates to those obtained from a prospective clinical registry; 2) current coding algorithms using the DAD had high validity for hypertension and diabetes, reflected in high values of sensitivity, specificity, PPV and NPV; and 3) validity was fairly consistent over 12 years and across age groups, sex and hospital locations. These findings support the use of the DAD for hypertension and diabetes surveillance, and suggest that recently observed increases in hypertension and diabetes prevalence are unlikely to be attributable to improved data quality.

Our finding of the high validity of hypertension and diabetes in administrative data is consistent with previous studies. Khokhar et al. reviewed validation studies of administrative data for defining diabetes [19]. Of 18 studies reviewed, sensitivity ranged from 51.78% to 100%, specificity ranged from 88% to 100%, PPV ranged from 21% to 99%, and NPV ranged from 60.32% to 99.63% [19]. Khokhar et al. reported that validity varied depending on study population and administrative data sources. Our results were also consistent with previous validation studies for hypertension [20-23]. Quan et al. reported that administrative data coding for hypertension, based on a case definition of "2 physician claims within 2 years or 1 hospitalization" had the highest validity, with sensitivity 75%, specificity 94%, PPV 81%, and NPV 92%. The high validity of coding for hypertension and diabetes may be related to a minimum two year professional coder training program, central management of coding practice, and resources allocation to record department, in Alberta [24,25].

Our findings support the use of the DAD for surveillance and temporal trend analysis for hypertension and diabetes. We found that data quality remained consistent regardless of patient age, sex, or hospital location. In Canada, hypertension and diabetes are mostly managed in outpatient clinics. Our validation study only contained data from hospitalizations. Therefore data quality at outpatient sites over time was unknown. In Alberta, as is the case with most other

Canadians provinces/territories, physicians submit claims with ICD diagnosis [26]. Cunningham et al. evaluated physician visit data quality (including inpatients and outpatient visits) in Alberta [27]. They concluded that physicians submitted a variety of ICD codes for claims and face validity of diagnosis coded in physician claims is substantially high [27]. Two Canadian studies (Quan et al. and Chen et al.) analyzed both inpatient and outpatient administrative data validity in defining hypertension and diabetes and did not find significant changes over years of 2001 and 2014 [6,12]. These two studies support our findings, although Januel et al reported that inpatient data validity improved after ICD-10 implementation in Switzerland [10].

Chronic disease surveillance is influenced by data quality. Because of imperfect data, accumulation of false positive and false negative cases over time using administrative data could result in biased estimation of hypertension and diabetes prevalence. Peng et al. evaluated these impacts on surveillance using sophisticated statistical methods and demonstrated that surveillance is less likely biased because false positive and negative cases are balanced out over time [28].

The major strength of this study is the scope. APPROACH is a prospective population based clinical registry with a very large number of observations over several years. This makes the assessment of time trends possible. However, our study is subject to limitations. First, our study assumes that the APPROACH registry is an accurate and suitable reference standard. Like many studies using clinical reference standards, our study does not confirm the reference standard accuracy. However, the use of trained clinicians for data entry, standardized definitions, and data quality and completeness check strategies within APPROACH support its use as a clinically accurate reference standard. The prospective data entry process within APPROACH also removes a major source of error that occurs as a result of time lag and translation. Second, we did not validate outpatient data over time for defining hypertension and diabetes. Third, we only validated data among patients who underwent coronary catheterization. PPV and NPV are influenced by disease frequency, and the high prevalence of hypertension and diabetes in patients with suspected coronary artery disease may produce higher estimates of PPV and lower estimates of NPV than in general population. Finally, our analysis was limited to data from Alberta. Data quality could vary by institutes and data collection management processes in other settings [29]. Caution should be applied in generalizing our findings to other regions or sites with less rigorous administrative data coding processes.

In conclusion, our study shows that DAD quality has remained consistent over 12 years for both hypertension and diabetes, supporting the use of administrative data for surveillance of these conditions. Further research on temporal trends in data quality of physician claims and ambulatory care databases needs to be conducted to confirm the effect of data quality from these sources on chronic disease prevalence trends.

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*** All Tables and Figures are also included in their Raw format in a separate Excel Spreadsheet**

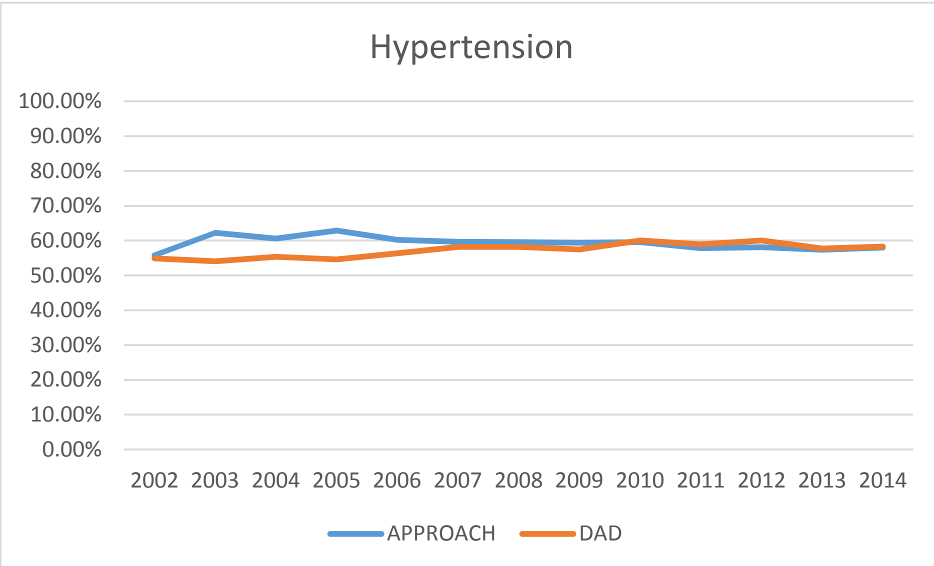
Table 1. Study population characteristics among patients underwent coronary artery cauterization in Alberta in 2002 and 2013

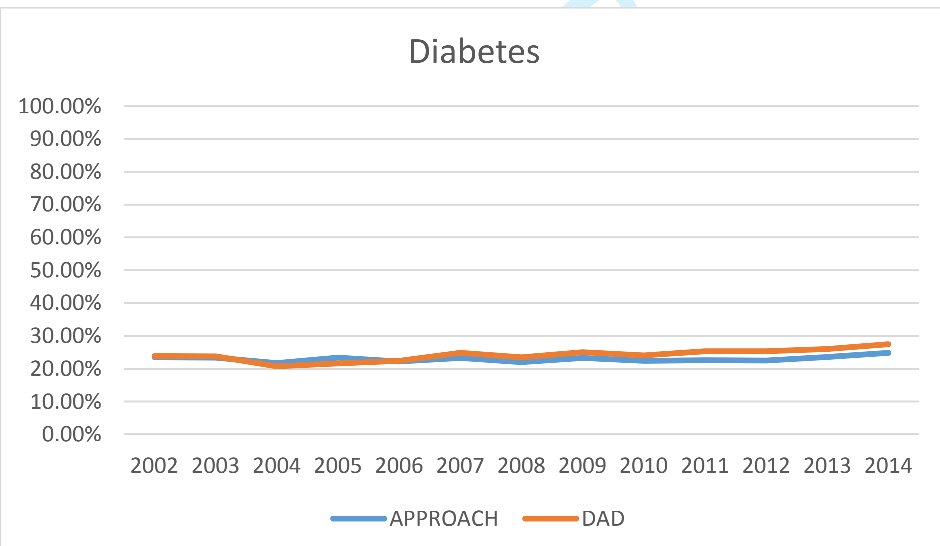
Patient Characteristics	**Year 2002**		**Year 2013**		**Change between 2002 and 2013 (95% Confidence Interval)**	
Age (Years)	63.8		62.6		-1.2 (-1.7, -0.6)	
Sex (Male)	69.9%		70.5%		0.7% (-1.2%, 2.5%)	
Location						
Calgary	48.1%		41.2%		-6.9% (-8.9%, -4.9%)	
Edmonton	42.6%		47.2%		4.6% (2.5%, 6.6%)	
Comorbidities (Prevalence)	**APPROACH***	**DAD***	**APPROACH**	**DAD**	**APPROACH**	**DAD**
Hyperlipidemia	69.5%	47.8%	60.8%	11.8%	-8.7% (-10.6%, -6.8%)	-36.0% (-37.7%, -34.2%)
Heart failure	11.4%	18.3%	8.1%	17.7%	-3.4% (-4.6%, -2.2%)	-0.6% (-2.2%, 1.0%)
Cerebrovascular disease	5.9%	3.8%	4.6%	1.8%	-1.3% (-2.2%, -0.4%)	-2.0% (-2.7%, -1.3%)
Peripheral vascular disease	7.3%	6.3%	2.9%	6.5%	-4.4% (-5.3%, -3.5%)	0.2% (-0.8%, 1.2%)
COPD	13.8%	10.9%	14.4%	9.2%	0.5% (-0.9%, 1.9%)	-1.7% (-2.9%, -0.4%)

*APPROACH: , the Alberta Provincial Project for Outcome Assessment in Coronary Heart Disease (APPROACH) database

DAD: Canadian hospital discharge abstract administrative data

Figure 1. Prevalence over time

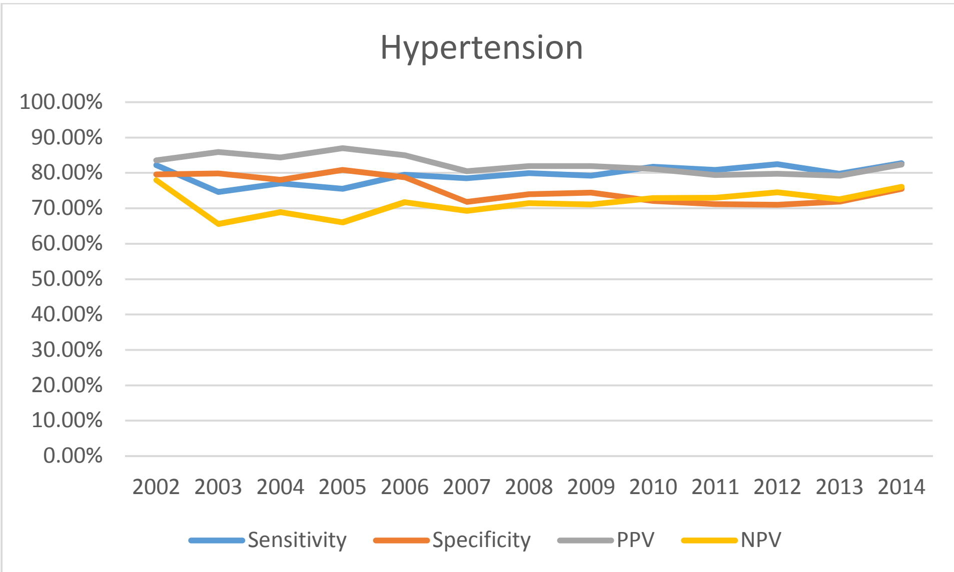




*APPROACH: , the Alberta Provincial Project for Outcome Assessment in Coronary Heart Disease (APPROACH) database

DAD: Canadian hospital discharge abstract administrative data

Figure 2. Validity over time



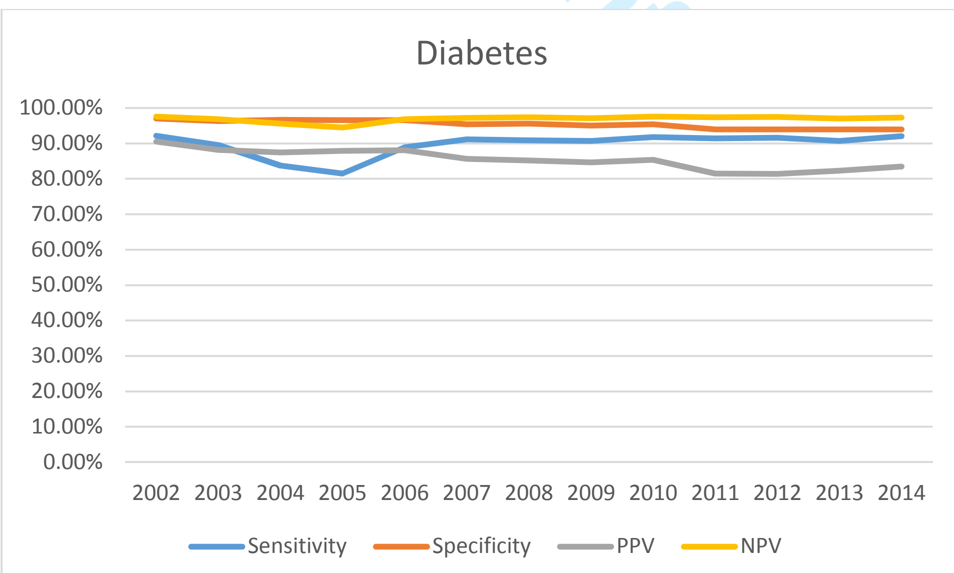


Table 2. Changes of prevalence of hypertension and diabetes between 2002 and 2013

		2002		2013		Change between 2002 and 2013 (95%	
		APPROACH*	DAD*	APPROACH	DAD	APPROACH	DAD
Hypertension		55.8%	54.9%	57.4%	57.8%	1.6% (-0.4%, 3.6%)	2.9% (0.9%, 4.
Age	18-64	48.5%	47.3%	49.1%	49.2%	0.6% (-2.2%, 3.4%)	1.9% (-0.9%, 4
	65+	63.5%	62.9%	67.7%	68.4%	4.2% (1.4%, 7.0%)	5.6% (2.8%, 8.
Sex	Male	53.5%	53.2%	56.1%	56.7%	2.6% (0.2%, 5.0%)	3.5% (1.1%, 5.
	Female	61.1%	58.9%	60.4%	60.4%	-0.7% (-4.3%, 2.9%)	1.5% (-2.2%, 5
City	Calgary	54.5%	55.6%	56.4%	56.1%	1.9% (-1.1%, 4.9%)	0.6% (-2.4%, 3
	Edmonton	56.9%	57.4%	55.4%	60.7%	-1.5% (-4.5%, 1.5%)	3.2% (0.2%, 6.
Diabetes		23.5%	23.9%	23.6%	26.0%	0.1% (-1.6%, 1.8%)	2.1% (0.4%, 3.
Age	18-64	19.5%	20.3%	19.6%	22.2%	0.0% (-2.2%, 2.3%)	1.9% (-0.4%, 4
	65+	27.6%	27.7%	28.6%	30.7%	1.0% (-1.7%, 3.6%)	3.1% (0.4%, 5.
Sex	Male	22.6%	23.0%	22.8%	25.7%	0.2% (-1.8%, 2.2%)	2.7% (0.6%, 4.
	Female	25.4%	26.0%	25.3%	26.8%	0.0% (-3.3%, 3.2%)	0.9% (-2.4%, 4
City	Calgary	24.0%	24.4%	22.8%	26.4%	-1.2% (-3.8%, 1.4%)	2.0% (-0.6%, 4
	Edmonton	22.8%	24.0%	23.0%	25.3%	0.2% (-2.4%, 2.7%)	1.3% (-1.4%, 3

*APPROACH: , the Alberta Provincial Project for Outcome Assessment in Coronary Heart Disease (APPROACH) database

DAD: Canadian hospital discharge abstract administrative data

Table 3. Validity of hypertension and diabetes in hospital diacharge abstract administrative data

Year		Hypertension				Diabetes			
		Sn. (%), (95%CI)	Sp. (%), (95% CI)	PPV (%), (95% CI)	NPV (%), (95% CI)	Sn. (%), (95%CI)	Sp. (%), (95% CI)	PPV (%), (95% CI)	NPV (%), (95% CI)
2002		82.2, (79.9-84.5)	79.6, (76.9-82.3)	83.6, (81.3-85.8)	78.0, (75.3-80.7)	92.1, (89.7-94.6)	97.0, (96.2-97.9)	90.5, (87.8-93.1)	97.6, (96.8-98.4)
2003		74.6, (72.5-76.7)	79.8, (77.3-82.3)	85.9, (84.1-87.7)	65.5, (62.9-68.2)	89.6, (87.2-92.0)	96.3, (95.5-97.2)	88.2, (85.6-90.7)	96.8, (96.0-97.6)
2004		77.1, (75.1-79.1)	78.1, (75.6-80.6)	84.4, (82.6-86.3)	68.9, (66.3-71.5)	83.8, (80.8-86.7)	96.7, (95.9-97.4)	87.5, (84.7-90.2)	95.5, (94.7-96.4)
2005		75.5, (73.5-77.6)	80.9, (78.4-83.3)	87.0, (85.3-88.7)	66.1, (63.4-68.7)	81.5, (78.5-84.5)	96.6, (95.8-97.4)	87.9, (85.3-90.6)	94.5, (93.5-95.4)
2006		79.5, (77.5-81.5)	78.8, (76.3-81.3)	85.0, (83.2-86.9)	71.7, (69.1-74.4)	88.9, (86.4-91.5)	96.6, (95.8-97.4)	88.1, (85.5-90.7)	96.8, (96.1-97.6)
2007		78.5, (76.4-80.6)	71.9, (69.1-74.6)	80.5, (78.4-82.5)	69.3, (66.5-72.1)	91.1, (88.8-93.5)	95.4, (94.4-96.3)	85.6, (82.9-88.4)	97.3, (96.5-98.0)
2008		80.0, (77.9-82.0)	74.0, (71.3-76.7)	81.9, (79.9-83.9)	71.5, (68.7-74.3)	90.8, (88.4-93.3)	95.5, (94.6-96.5)	85.2, (82.3-88.1)	97.4, (96.6-98.1)
2009		79.3, (77.2-81.4)	74.5, (71.7-77.2)	81.9, (79.9-84.0)	71.1, (68.3-73.8)	90.7, (88.3-93.1)	95.0, (94.0-96.0)	84.6, (81.8-87.5)	97.1, (96.3-97.9)
2010		81.8, (79.8-83.7)	72.1, (69.3-74.8)	81.2, (79.2-83.1)	72.9, (70.1-75.6)	91.8, (89.5-94.0)	95.4, (94.5-96.4)	85.3, (82.5-88.1)	97.6, (96.9-98.3)
2011		80.8, (78.8-82.9)	71.2, (68.4-73.9)	79.4, (77.3-81.4)	73.0, (70.3-75.7)	91.4, (89.1-93.7)	93.9, (92.9-95.0)	81.5, (78.5-84.5)	97.4, (96.7-98.1)
2012		82.5, (80.6-84.4)	71.0, (68.3-73.7)	79.8, (77.8-81.7)	74.5, (71.9-77.1)	91.6, (89.4-93.8)	93.9, (92.9-95.0)	81.4, (78.5-84.3)	97.5, (96.8-98.2)
2013		79.8, (77.8-81.8)	71.9, (69.3-74.5)	79.3, (77.3-81.3)	72.5, (70.0-75.1)	90.7, (88.5-93.0)	94.0, (93.0-95.0)	82.3, (79.5-85.1)	97.0, (96.3-97.8)
Age	<65	76.9, (73.9-79.9)	77.6, (74.6-80.5)	76.8, (73.8-79.8)	77.7, (74.7-80.6)	89.4, (85.9-92.9)	94.2, (92.9-95.5)	78.9, (74.5-83.3)	97.3, (96.4-98.3)
	65+	82.4, (79.8-85.0)	60.8, (56.0-65.7)	81.5, (78.8-84.1)	62.3, (57.4-67.1)	91.8, (88.9-94.7)	93.7, (92.1-95.3)	85.3, (81.8-88.9)	96.6, (95.4-97.8)
Sex	Male	79.2, (76.8-81.6)	72.1, (69.1-75.2)	78.4, (76.0-80.9)	73.1, (70.1-76.1)	91.8, (89.2-94.3)	93.9, (92.7-95.1)	81.7, (78.3-85.1)	97.5, (96.7-98.3)
	Female	81.1, (77.6-84.6)	71.3, (66.3-76.3)	81.2, (77.7-84.6)	71.2, (66.2-76.1)	88.5, (84.1-92.9)	94.1, (92.3-96.0)	83.7, (78.7-88.6)	96.0, (94.4-97.6)
City	Calgary	76.3, (73.0-79.7)	70.1, (66.0-74.1)	76.8, (73.5-80.1)	69.6, (65.5-73.6)	91.6, (88.2-95.0)	92.8, (91.1-94.6)	79.1, (74.5-83.7)	97.4, (96.3-98.5)
	Edmonton	86.5, (84.0-89.0)	71.5, (67.8-75.2)	79.0, (76.2-81.9)	81.0, (77.6-84.4)	91.7, (88.6-94.9)	94.5, (93.1-95.9)	83.3, (79.3-87.4)	97.5, (96.5-98.5)

Table 1. Study population characteristics among patients who underwent coronary artery cathterization i

Patient Characteristics	2002		2013		Change
Age	63.8		62.6		-1.2 (-
Sex (Male)	69.9%		70.5%		0.7% (-1
Location					
Calgary	48.1%		41.2%		-6.9% (-8
Edmonton	42.6%		47.2%		4.6% (2
Common Comorbidities (Prevalence)	**APPROACH***	**DAD***	**APPROACH**	**DAD**	**APPROACH**
Hyperlipidemia	69.5%	47.8%	60.8%	11.8%	-8.7% (-10.6%, -6.8%)
Heart Failure	11.4%	18.3%	8.1%	17.7%	-3.4% (-4.6%, -2.2%)
CEVD	5.9%	3.8%	4.6%	1.8%	-1.3% (-2.2%, -0.4%)
PVD	7.3%	6.3%	2.9%	6.5%	-4.4% (-5.3%, -3.5%)
COPD	13.8%	10.9%	14.4%	9.2%	0.5% (-0.9%, 1.9%)

* APPROACH; Alberta Provincial Project for Outcome Assessment in Coronary Heart Disease
* DAD; Hospital Discharge Abstract Database

n Alberta in 2002 and 2013

e (95% CI)
1.7, -0.6)
..2%, 2.5%)
3.9%, -4.9%)
.5%, 6.6%)

DAD
-36.0% (-37.7%, -34.2%)
-0.6% (-2.2%, 1.0%)
-2.0% (-2.7%, -1.3%)
0.2% (-0.8%, 1.2%)
-1.7% (-2.9%, -0.4%)

Table 2. Changes of prevalence of hypertension and diabetes between 2002 and 2013

		2002		2013		Change between 20
		APPROACH*	DAD*	APPROACH	DAD	APPROACH
Hypertension		55.8%	54.9%	57.4%	57.8%	1.6% (-0.4%, 3.6%)
Age	18-64	48.5%	47.3%	49.1%	49.2%	0.6% (-2.2%, 3.4%)
	65+	63.5%	62.9%	67.7%	68.4%	4.2% (1.4%, 7.0%)
Sex	Male	53.5%	53.2%	56.1%	56.7%	2.6% (0.2%, 5.0%)
	Female	61.1%	58.9%	60.4%	60.4%	-0.7% (-4.3%, 2.9%)
City	Calgary	54.5%	55.6%	56.4%	56.1%	1.9% (-1.1%, 4.9%)
	Edmonton	56.9%	57.4%	55.4%	60.7%	-1.5% (-4.5%, 1.5%)
Diabetes		23.5%	23.9%	23.6%	26.0%	0.1% (-1.6%, 1.8%)
Age	18-64	19.5%	20.3%	19.6%	22.2%	0.0% (-2.2%, 2.3%)
	65+	27.6%	27.7%	28.6%	30.7%	1.0% (-1.7%, 3.6%)
Sex	Male	22.6%	23.0%	22.8%	25.7%	0.2% (-1.8%, 2.2%)
	Female	25.4%	26.0%	25.3%	26.8%	0.0% (-3.3%, 3.2%)
City	Calgary	24.0%	24.4%	22.8%	26.4%	-1.2% (-3.8%, 1.4%)
	Edmonton	22.8%	24.0%	23.0%	25.3%	0.2% (-2.4%, 2.7%)

* APPROACH; Alberta Provincial Project for Outcome Assessment in Coronary Heart Disease
* DAD; Hospital Discharge Abstract Data

02 and 2013 (95% CI)
DAD
2.9% (0.9%, 4.9%)
1.9% (-0.9%, 4.7%)
5.6% (2.8%, 8.4%)
3.5% (1.1%, 5.9%)
1.5% (-2.2%, 5.1%)
0.6% (-2.4%, 3.6%)
3.2% (0.2%, 6.2%)
2.1% (0.4%, 3.9%)
1.9% (-0.4%, 4.2%)
3.1% (0.4%, 5.8%)
2.7% (0.6%, 4.7%)
0.9% (-2.4%, 4.1%)
2.0% (-0.6%, 4.6%)
1.3% (-1.4%, 3.9%)

Table 3. Validaty of hypertension and diabetes in hospital discharge abstract data

Year		Hypertension			
		Sn. (%), (95%CI)	Sp. (%), (95% CI)	PPV (%), (95% CI)	NPV (%), (95% CI)
2002		82.2, (79.9-84.5)	79.6, (76.9-82.3)	83.6, (81.3-85.8)	78.0, (75.3-80.7)
2003		74.6, (72.5-76.7)	79.8, (77.3-82.3)	85.9, (84.1-87.7)	65.5, (62.9-68.2)
2004		77.1, (75.1-79.1)	78.1, (75.6-80.6)	84.4, (82.6-86.3)	68.9, (66.3-71.5)
2005		75.5, (73.5-77.6)	80.9, (78.4-83.3)	87.0, (85.3-88.7)	66.1, (63.4-68.7)
2006		79.5, (77.5-81.5)	78.8, (76.3-81.3)	85.0, (83.2-86.9)	71.7, (69.1-74.4)
2007		78.5, (76.4-80.6)	71.9, (69.1-74.6)	80.5, (78.4-82.5)	69.3, (66.5-72.1)
2008		80.0, (77.9-82.0)	74.0, (71.3-76.7)	81.9, (79.9-83.9)	71.5, (68.7-74.3)
2009		79.3, (77.2-81.4)	74.5, (71.7-77.2)	81.9, (79.9-84.0)	71.1, (68.3-73.8)
2010		81.8, (79.8-83.7)	72.1, (69.3-74.8)	81.2, (79.2-83.1)	72.9, (70.1-75.6)
2011		80.8, (78.8-82.9)	71.2, (68.4-73.9)	79.4, (77.3-81.4)	73.0, (70.3-75.7)
2012		82.5, (80.6-84.4)	71.0, (68.3-73.7)	79.8, (77.8-81.7)	74.5, (71.9-77.1)
2013		79.8, (77.8-81.8)	71.9, (69.3-74.5)	79.3, (77.3-81.3)	72.5, (70.0-75.1)
Age	<65	76.9, (73.9-79.9)	77.6, (74.6-80.5)	76.8, (73.8-79.8)	77.7, (74.7-80.6)
	65+	82.4, (79.8-85.0)	60.8, (56.0-65.7)	81.5, (78.8-84.1)	62.3, (57.4-67.1)
Sex	Male	79.2, (76.8-81.6)	72.1, (69.1-75.2)	78.4, (76.0-80.9)	73.1, (70.1-76.1)
	Female	81.1, (77.6-84.6)	71.3, (66.3-76.3)	81.2, (77.7-84.6)	71.2, (66.2-76.1)
City	Calgary	76.3, (73.0-79.7)	70.1, (66.0-74.1)	76.8, (73.5-80.1)	69.6, (65.5-73.6)
	Edmonton	86.5, (84.0-89.0)	71.5, (67.8-75.2)	79.0, (76.2-81.9)	81.0, (77.6-84.4)

Diabetes			
Sn. (%), (95%CI)	**Sp. (%), (95% CI)**	**PPV (%), (95% CI)**	**NPV (%), (95% CI)**
92.1, (89.7-94.6)	97.0, (96.2-97.9)	90.5, (87.8-93.1)	97.6, (96.8-98.4)
89.6, (87.2-92.0)	96.3, (95.5-97.2)	88.2, (85.6-90.7)	96.8, (96.0-97.6)
83.8, (80.8-86.7)	96.7, (95.9-97.4)	87.5, (84.7-90.2)	95.5, (94.7-96.4)
81.5, (78.5-84.5)	96.6, (95.8-97.4)	87.9, (85.3-90.6)	94.5, (93.5-95.4)
88.9, (86.4-91.5)	96.6, (95.8-97.4)	88.1, (85.5-90.7)	96.8, (96.1-97.6)
91.1, (88.8-93.5)	95.4, (94.4-96.3)	85.6, (82.9-88.4)	97.3, (96.5-98.0)
90.8, (88.4-93.3)	95.5, (94.6-96.5)	85.2, (82.3-88.1)	97.4, (96.6-98.1)
90.7, (88.3-93.1)	95.0, (94.0-96.0)	84.6, (81.8-87.5)	97.1, (96.3-97.9)
91.8, (89.5-94.0)	95.4, (94.5-96.4)	85.3, (82.5-88.1)	97.6, (96.9-98.3)
91.4, (89.1-93.7)	93.9, (92.9-95.0)	81.5, (78.5-84.5)	97.4, (96.7-98.1)
91.6, (89.4-93.8)	93.9, (92.9-95.0)	81.4, (78.5-84.3)	97.5, (96.8-98.2)
90.7, (88.5-93.0)	94.0, (93.0-95.0)	82.3, (79.5-85.1)	97.0, (96.3-97.8)
89.4, (85.9-92.9)	94.2, (92.9-95.5)	78.9, (74.5-83.3)	97.3, (96.4-98.3)
91.8, (88.9-94.7)	93.7, (92.1-95.3)	85.3, (81.8-88.9)	96.6, (95.4-97.8)
91.8, (89.2-94.3)	93.9, (92.7-95.1)	81.7, (78.3-85.1)	97.5, (96.7-98.3)
88.5, (84.1-92.9)	94.1, (92.3-96.0)	83.7, (78.7-88.6)	96.0, (94.4-97.6)
91.6, (88.2-95.0)	92.8, (91.1-94.6)	79.1, (74.5-83.7)	97.4, (96.3-98.5)
91.7, (88.6-94.9)	94.5, (93.1-95.9)	83.3, (79.3-87.4)	97.5, (96.5-98.5)

Figure 1. Prevalence over time

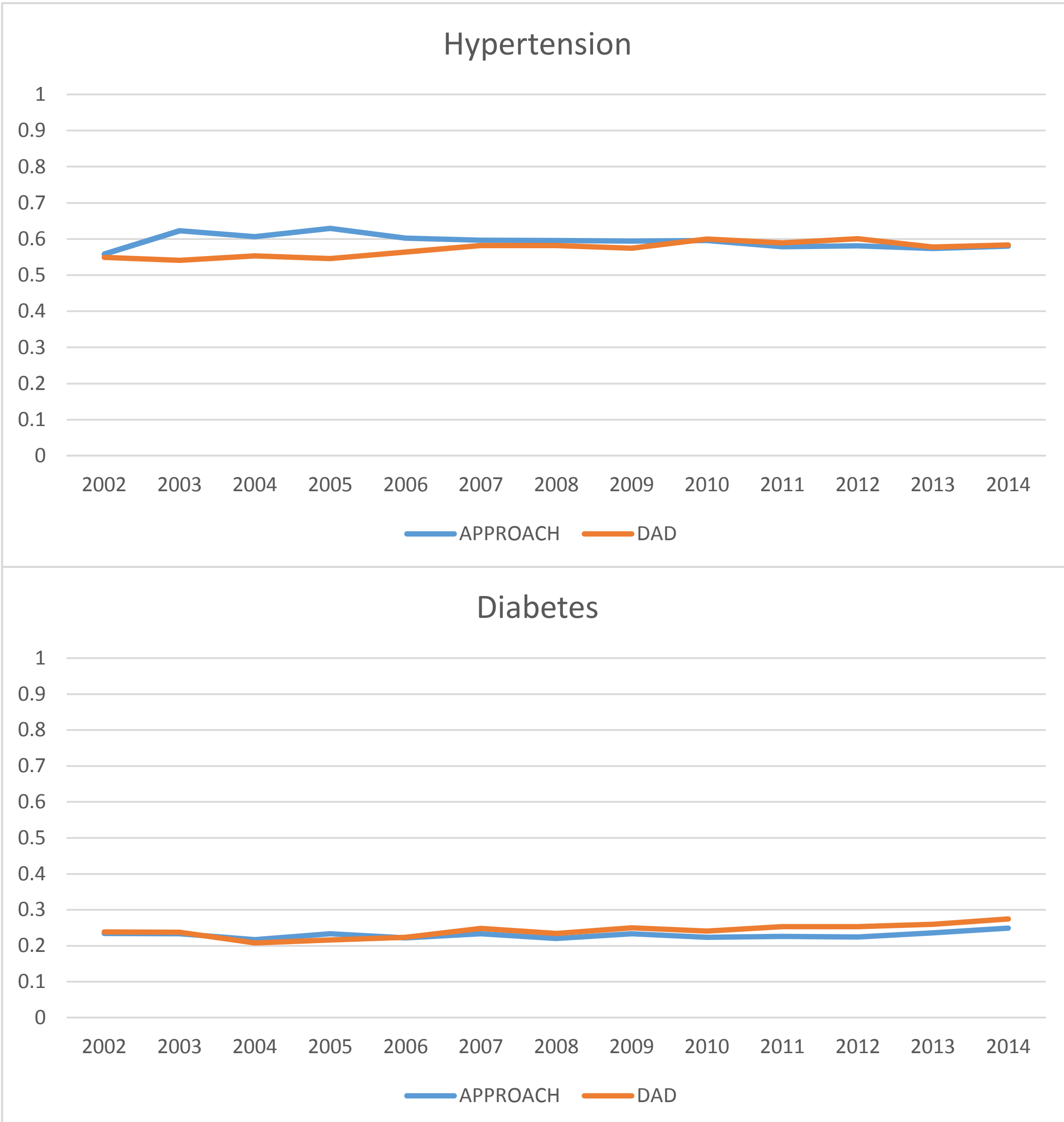


Figure 2. Validity over time