

# The changing profile of the cardiovascular patient and the future of cardiovascular disease treatment and prevention: British Columbia as an example

Zmiany w charakterystyce pacjentów z chorobami sercowo-naczyniowymi oraz zapobieganie tym chorobom i leczenie ich w przyszłości na przykładzie Brytyjskiej Kolumbii (Kanada)

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*"You know," he said, "sometimes it feels like this. There I am, standing by the shore of a swiftly flowing river and I hear the cry of a drowning man. So I jump into the river, put my arms around him, pull him to shore and apply artificial respiration. Just when he begins to breathe, there is another cry for help. So I jump into the river, reach him, pull him to shore, apply artificial respiration, and then just as he begins to breathe, another cry for help. So back in the river again, reaching, pulling, applying, breathing and then another yell. Again and again, without end, goes the sequence. You know, I am so busy jumping in, pulling them to shore, applying artificial respiration, that I have no time to see who the hell is upstream pushing them all in."*

[Source: I.K. Zola, 'Helping: Does It Matter? The Problems and Prospects of Mutual Aid Groups,' Addressed to the United Ostomy Association, 1970; Printed in: *The Sociology of Health & Illness: Critical Perspectives, Seventh Edition*, by Peter Conrad, p. 551]

The term cardiovascular disease (CVD) refers to any disorder that affects the heart's ability to act normally, although this term is usually used to refer to those diseases related to atherosclerosis. The CVD can be prevented by early intervention focusing on identification and treatment of high-risk patients (so-called 'primary prevention'), as well as by identifying and treating others with so-called CVD-risk equivalents such as: diabetes mellitus, peripheral artery disease, chronic kidney disease (CKD), and chronic obstructive lung disease.

The past three decades have seen significant changes in the way patients with established CVD are treated. Starting with thrombolytic treatment for ST elevation myocardial infarction, through aggressive use of percutaneous coronary interventions for acute coronary syndromes, to coronary artery bypass grafting (CABG) surgery for more complex coronary artery disease, revascularisation procedures have become a standard of treatment applied widely across populations through a standardised, guideline-driven care.

These interventions have produced desired effects: according to Statistics Canada, between 2000 and 2004, the age-standardised mortality rate for CVD dropped by 16%, from

209 to 176 deaths per 100,000 population (Table 1) [1]. Previous trends showed that mortality rates halved between 1969 and 1997 [2]. Nevertheless, CVD continues to be a leading cause of death in the industrialised world, responsible for 30% of all deaths in Canada in 2007 (Fig. 1) [3].

Cardiovascular disease also continues to be a significant financial burden on healthcare costs, accounting (in the latest available figures) for a total of CDN\$6.8 billion in terms of direct care (hospital care, drugs, physician care, other institution care, etc.) and CDN\$11.6 billion in indirect costs (due to mortality and disability) in 1998 (Fig. 2) [4].

The province of British Columbia shows similar trends: in 1999, CVD accounted for 36% of all deaths [5], and in 1998 CVD was the most costly disease to treat, comprising 11.6% of the total costs of healthcare [4].

Interestingly, in the last decade, the rate at which CVD mortality has decreased has begun to taper off, which is thought to be largely due to an ageing population and the increasing prevalence of chronic diseases [6].

In 2010, the Heart and Stroke Foundation of Canada reported that one in five Canadian adults between the ages

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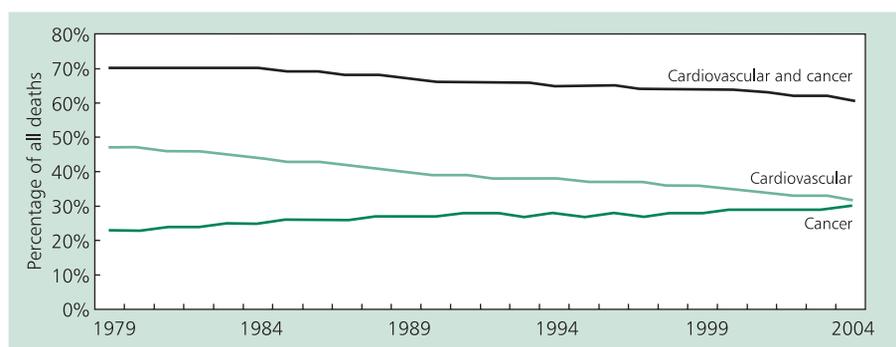
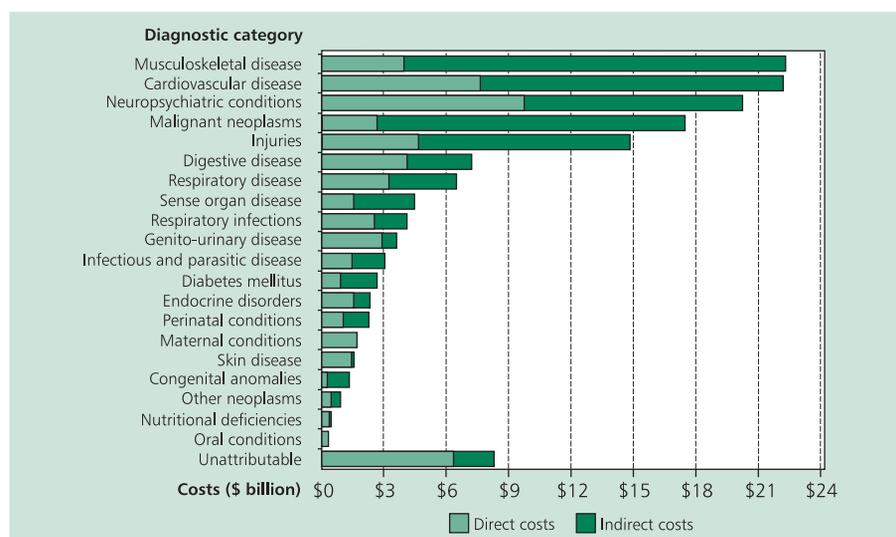
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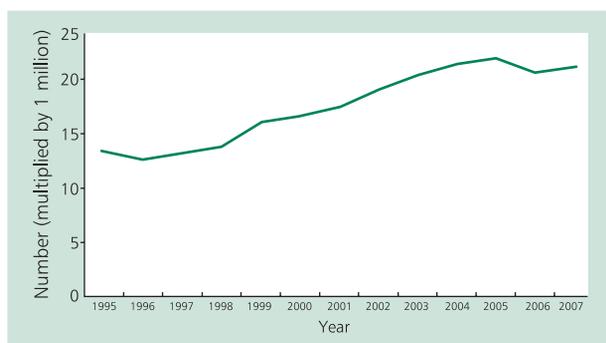
**Table 1.** Age-standardised mortality rates\* for cardiovascular disease and cancer, by sex, Canada, 2000 to 2004

Year	Cardiovascular disease			Cancer		
	Both sexes	Males	Females	Both sexes	Males	Females
2000	209.1	268.3	164.0	180.4	225.3	149.4
2001	197.5	252.6	155.4	178.7	223.8	147.6
2002	192.1	244.9	151.9	178.2	220.5	149.3
2003	185.0	238.4	144.0	175.6	215.3	148.1
2004	175.6	223.7	137.9	173.7	212.1	147.0

\*Age-standardised mortality rate per 100,000 population

**Figure 1.** Percentage share of deaths due to cardiovascular diseases, cancer and both causes, Canada, 1979 to 2004

**Figure 2.** Costs due to disease\* for the leading 20 diagnostic categories, by direct\*\*, and indirect costs\*\*\*, Canada 2000; \*based on the total cost of illness of \$147.9 billion. Expenditures for care in other institutions and additional direct health expenditures are not included; \*\*direct costs include hospitals, drugs and physicians; \*\*\*indirect costs include mortality, long-term disability and short-term disability; Note: not all diagnostic categories include short-term disability costs. The four diagnostic categories that include short-term disability costs are: cardiovascular disease, musculoskeletal disease, respiratory disease and respiratory infections. Costs by diagnostic category include an unattributable amount of \$6.4 billion for direct costs and \$1.9 billion for indirect costs (short-term disability only). Costs by diagnostic category related to suppressed cells for long-term disability are excluded from the total indirect costs. Source: Public Health Agency of Canada, using data from the Economic Burden of Illness in Canada 2000



**Figure 3.** Number of physician visits for high blood pressure, by year, Canada, 1995–2007; Source: Chronic Disease Surveillance Division, Centre for Chronic Disease Prevention and Control, Public Health Agency of Canada, using data from the Canadian Disease and Therapeutic Index Database (IMS Health)

of 50 and 64 had at least two of the major risk factors for CVD: diabetes, hypertension, smoking, and particularly obesity, the rate of which skyrocketed between 1994 and 2005. Despite significant improvement in treatment of some risk factors such as hyperlipidaemia and hypertension, Canadian rates of hypertension increased during this time by 77%, with a proportional rise of 10 million physician visits for high blood pressure from 1995 to 2007 (Fig. 3). Other conditions such as obesity grew by 18%, and consequently diabetes rose by 45%, perhaps also reflecting increased diagnostic vigilance, which however contributed to increasing chronic disease rates in both older and younger population cohorts [7].

In 2005, it was estimated that 1.3 million Canadians, or 3.9% of the population, had been diagnosed with diabetes, with the caveat that an estimated 2% of Canadians still remained undiagnosed and an additional 3.5% had undiagnosed glucose intolerance. In British Columbia in 2005, 4.6% of the population had been diagnosed with diabetes [8]. By 2010, this figure had risen to 6.4% Canada-wide [9]. Of note is that at the time of diabetes diagnosis, 27% of patients have established nephropathy, 22% have established retinopathy [10], and a whopping 50% have established CVD [11].

Chronic kidney disease, like diabetes, has been identified as a cardiovascular risk equivalent by the American Heart Association, and has been found to affect an estimated two million Canadians [12], with an overall prevalence of 35% in the over 66 year-old population [13]. Recently, chronic obstructive pulmonary disease (COPD) has emerged as an independent risk factor of CVD [14]; in 2010, more than 805,000 Canadians reported that they had COPD, a slight decrease from the 837,000 in 2008 [15].

As the British Columbia and Canadian populations continue to age, it is anticipated that from 2005 to 2021, the population over the age of 65 will increase by 42% in British Columbia and by 36% in Canada. A projection suggests that those aged 65+ will make up almost a quarter of the total

British Columbia population in 2036, resulting in a further proportional rise in the incidence of chronic diseases [7].

In 2010, Statistics Canada estimated the population of British Columbia to be 4,530,960 [16], which corresponds to estimates of 455,000 British Columbians with COPD, 455,000 with diabetes and 725,000 with CKD. Despite overlaps in these patient subpopulations, it is clear that as many as 1.7 million British Columbians, 37% of the total population, are at increased risk of developing CVD or may have already developed CVD that is not yet clinically apparent [17].

The fact that CVD mortality has been decreasing steadily is certainly also due to better lifestyle measures, including less smoking, more physical activity, increased consumption of fruits and vegetables and decreased consumption of saturated fats, as well as to more aggressive pharmacological management of elevated blood pressure, lipids and diabetes. Due to increased awareness in the medical community, CVD itself is being diagnosed earlier, and as mentioned above, the treatment of established CVD has improved with increasing access to revascularisation procedures. For example, deaths due to heart attacks decreased to 18,125 in 2004 from 31,457 in 1969 [18]. After adjusting for population increase and the ageing population, the age-standardised myocardial infarction mortality rate decreased 6.4 fold since 1969. Cardiovascular disease-related hospitalisations have proportionally decreased in all age brackets except for the 85+ category, although this may be attributable to the ageing population and the larger size of the 85+ group (Fig. 4).

As a result, there is less demand for the use of angiography, and interventional procedures, particularly CABG (Table 2).

The current challenges of general practitioners include identifying patients at high risk for the development of CVD and ensuring that such patients receive appropriate treatment. High-risk individuals should be targeted with an aggressive approach to CVD prevention [17]. As such, current cardiovascular risk assessment tools are used to estimate a ten-year risk for cardiovascular event, with the Framingham risk score (FRS) and European Society of Cardiology EuroSCORE being the most widely employed. However, these screening tools are not entirely accurate; for example, the EuroSCORE underestimates the total of fatal and nonfatal rates of ten-year risk of atherosclerotic death, including outcomes such as myocardial infarction, aortic dissection, and stroke, by a factor of 2 [19]. Furthermore, risk assessment scores, such as FRS, are less reliable for patients who are not of Northern European heritage, have a family history of premature CVD, or who possess a single CVD risk-equivalent risk factor (such as familial hypercholesterolaemia, hypertension, diabetes, CKD, or COPD) [20].

There remains evidence of suboptimal management of elevated risk and suboptimal use of medications which are systematically underused in this high-risk population, even among patients with established atherosclerotic disease [21]. Aspirin, angiotensin-converting enzyme inhibitors, angioten-



**Figure 4.** Number and rate of hospitalisations due to cardiovascular disease\*, by year, Canada, 1971/72 – 2005/06; \*ICD-10-CA codes: 100–199; \*\*standardised to the 1991 Canadian population. Note: hospitalisations are based on the most responsible diagnosis for length of stay in hospital. The coding schemes for this condition changes in 1979 to 2001, and this may influence trends. Prior to 1993/94, only included the ten Canadian provinces. Nunavut data not available in 2002/03. Quebec data not available in 2005/06. Source: Chronic Disease Surveillance Division, Centre for Chronic Disease Prevention and Control, Public Health Agency of Canada, using data from the Hospital Morbidity Database (Canadian Institute for Health Information)

**Table 2.** Community and health system characteristics, British Columbia

Indicator	2006	2007	2008	2009
Cardiac revascularisation — both sexes	239.7	232	227	219
Age-standardised rate/100,000 (95% CI)	(234.8–244.5)	(227–237)	(222–231)	(214–223)
Cardiac revascularisation — female	112.8	107	104	101
Age-standardised rate/100,000 (95% CI)	(108.1–117.4)	(102–111)	(100–108)	(97–106)
Cardiac revascularisation — male	374.5	365	358	344
Age-standardised rate/100,000 (95% CI)	(365.8–383.3)	(356–373)	(349–366)	(336–352)

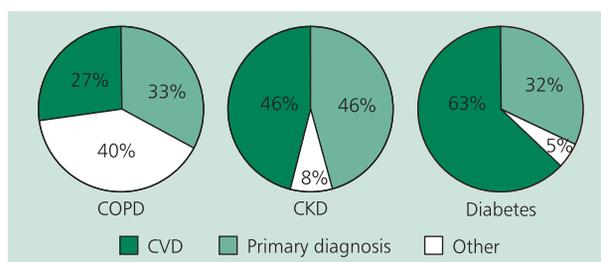
Indicator	2004	2005	2006	2007	2008	2009
Coronary artery bypass graft — both sexes	73.3	69.6	65.9	65	62	59
Age-standardised rate/100,000 (95% CI)	(70.5–76.1)	(66.9–72.3)	(63.4–68.5)	(63–68)	(59–64)	(57–61)
Coronary artery bypass graft — female	28.2	25.8	26.3	23	25	24
Age-standardised rate/100,000 (95% CI)	(25.8–30.7)	(23.5–28.0)	(24.0–28.6)	(21–25)	(22–27)	(22–26)
Coronary artery bypass graft — male	121.8	116.2	108.4	111	101	97
Age-standardised rate/100,000 (95% CI)	(116.6–127.0)	(111.2–121.2)	(103.7–113.2)	(106–116)	(96–105)	(93–102)

CI — confidence interval

sin receptor blockers, beta-blockers and statins have been shown to improve cardiovascular outcomes in patients with diabetes, COPD and CKD, with or without hypertension, and regardless of LDL cholesterol levels [19, 20] as it is postulated that a high proportion of patients with these conditions will succumb to CVD (Fig. 5).

A recent Canadian study demonstrated the beneficial effects of these drugs, and concluded that a dual ‘cardiopulmonary protective’ effect may exist for some of these medications that could potentially reduce clinically significant end-points [22].

If we add the estimated 1.7 million British Columbians at high risk for developing CVD due to the presence of



**Figure 5.** Causes of death for patients with a primary diagnosis of chronic obstructive pulmonary disease (COPD), chronic kidney disease (CKD), or diabetes. Rates of death directly attributable to cardiovascular disease (CVD) are compared to those attributable to the primary diagnosis and other causes of mortality

diabetes, CKD or COPD, to those already diagnosed with established CVD, there may be as many as 2 million people, almost half of the British Columbian population, who require aggressive lifestyle and possibly pharmacologic intervention.

Therefore, it is necessary for our new generation of cardiologists to be well trained in CVD prevention, and to pass this knowledge to family physicians and other allied health professionals such as nurse practitioners etc. The modern cardiologist must be able to function as a chronic disease manager to ensure that these patients are treated as high-risk targets. Other internal medicine subspecialists, endocrinologists and nephrologists in particular, have already *de facto* adopted the chronic disease model and have become champions of it.

There are certainly going to be significant challenges in adopting this model in a cardiology community used to fragmented care during acute exacerbations of CVD, such as at the time of acute coronary syndrome or arrhythmia. Certainly, the new model must include proper performance of these often life-saving procedures. Possible solutions may include increased use of allied health professionals, such as nurses, or even changing the way that compensation for CVD services is provided.

As our population continues to age, there is a need for a paradigm shift in the treatment of CVD: CVD mortality is decreasing, but there is a proportional rise in chronic diseases that convey increased risk to otherwise healthy patients. It is necessary for cardiologists to shift the emphasis from emergency and acute care to chronic disease management to allow for early identification and treatment of these high-risk patients, lest the gains from the past three decades be squandered.

**Conflict of interest:** none declared

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