Discussing Coronary Risk with Patients to Improve Blood Pressure Treatment: Secondary Results from the CHECK-UP Study

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OBJECTIVES: Hypertension is common among patients with dyslipidemia but is often poorly treated. The objective of this analysis was to evaluate how a decision aid, used by primary care physicians to improve lipid therapy, impacted on the treatment of hypertension.

STUDY DESIGN: Data were analyzed from patients enrolled in a randomized trial focusing primarily on the treatment of dyslipidemia. Patients received usual care or a coronary risk profile every three months to monitor the risk reduction following lifestyle changes and/or pharmacotherapy to treat dyslipidemia. Hypertension management was assessed based on a post hoc analysis of individuals whose blood pressure exceeded current national hypertension guidelines.

RESULTS: There were 2,631 subjects who completed the study. Among 1,352 patients without diagnosed hypertension, 30% were above target on at least three consecutive visits. Among 1,279 individuals with known hypertension, 69% were above target on at least two consecutive visits. Overall, patients receiving risk profiles were more likely to receive appropriate antihypertensive therapy (OR=1.40, 95% CI 1.11 – 1.78) compared to those receiving usual care. After adjustment for inter-physician variability and potential confounders, the use of the risk profile was associated with an increased likelihood of starting therapy (OR=1.78, 95% CI 1.06 – 3.00) or modifying therapy (OR=1.40, 95% CI 1.03 – 1.91).

CONCLUSIONS: In this clinical trial of dyslipidemia management, inadequately controlled hypertension was common, occurring in nearly 50% of individuals. Ongoing coronary risk assessment was associated with more appropriate blood pressure management. Cardiovascular risk assessment decision aids should be further evaluated in a randomized trial of hypertension therapy.

KEY WORDS: patient education; hypertension; cardiovascular disease; preventive care; communication.
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INTRODUCTION

There is little debate that the treatment of hypertension can reduce the morbidity and mortality associated with cardiovascular disease[1–5]. Despite the consensus and mounting clinical evidence supporting treatment, many patients do not achieve recommended blood pressure targets[1–5]. Reasons for this are many including inadequate treatment by physicians and suboptimal patient adherence to prescribed therapy[6–11]. The resulting treatment gap between prevention guidelines and actual clinical practice is now recognized as one of the major challenges facing health care providers in their efforts to prevent coronary disease[12].

A survey of American physicians by Mosca et al. [13] demonstrated that most physicians do not believe they are effective in helping their patients prevent cardiovascular disease. The study identified that the physician's perception of coronary risk for the individual patient was the primary factor associated with prescribing treatment. The authors concluded that educational efforts to assist physicians in coronary risk assessment might increase awareness and adoption of CVD prevention guidelines. These recommendations are consistent with the 2002 American Heart Association guidelines for the primary prevention of coronary disease and stroke[14]. These guidelines recommend that one approach to reducing the treatment gap is to forge a

physician — patient partnership by assessing the individual patient's coronary risk and communicating this risk when developing a plan of action with the patient.

The CHECK-UP study was a randomized clinical trial to evaluate the effectiveness of a clinical decision aid to improve the treatment of dyslipidemia and reduce the risk of coronary disease among Canadian patients seen in primary care physicians' offices[15]. Individuals with dyslipidemia were randomly assigned to receive usual care or a personalized risk profile in which the future risk of cardiovascular events and potential benefits of modifying specific risk factors were calculated. As anticipated, a substantial portion of patients enrolled in the study had hypertension, both treated and untreated. We, therefore, evaluated the spill-over effect of the risk profile on the treatment of hypertension.

METHODS

Study Design

The CHECK-UP study has previously been described in detail[15]. In this randomized trial, a clinical decision aid was evaluated to determine if ongoing global risk assessment with a coronary risk profile would improve the effectiveness of treating dyslipidemia in a primary care setting. Briefly, 230 primary care physicians enrolled 3,053 patients to participate and 2,687 completed the 12 months of follow-up as of August 2003. Subjects were stratified by risk level and randomized by the central coordinating centre to receive printed, individualized risk profiles or usual care. This post hoc analysis was completed among those who finished the study (n=2,631) with complete blood pressure data.

Inclusion criteria were based on the 2000 Canadian Working Group Lipid guidelines and included males or females age 30–70 with CVD or diabetes, or males 45–70 and females 55–70 who had a calculated 10-year coronary risk $\geq$ 10% based on Framingham equations[16]. At screening, subjects provided written informed consent and had a complete medical evaluation including a full lipid profile.

Subjects were eligible for the study if they met the following criteria:

1. Their risk level was considered very high (had cardiovascular disease, or diabetes present, or a calculated 10-year coronary risk greater than 30%) and their LDL-cholesterol (LDL-C) was equal to or greater than 2.5 mmol/L or their total cholesterol/HDL (TC/HDL) ratio was equal to or greater than 4.
2. Their risk level was high (calculated 10-year risk of 21–30%) and their LDL-C was equal to or greater than 3.0 mmol/L or their TC/HDL ratio was equal to or greater than 5.
3. Their risk level was moderate (calculated 10-year risk of 10–20%) and their LDL-C was equal to or greater than 4.0 mmol/L or their TC/HDL ratio was equal to or greater than 6.

The Coronary Risk Profile

The coronary risk profile is a one-page computer printout that displays a subject's probability of developing coronary disease over an 8-year period. For individuals without CVD, these risk estimates were based on Framingham data[17]. For those with CVD, risk was calculated using the Cardiovascular Life Expectancy Model, [18] which is based on data from the Lipid Research Clinics Follow-up Cohort. For those without CVD, the profile also included their cardiovascular age calculated as the patients' age plus the difference between their estimated life-expectancy, adjusted for their risk of coronary disease and stroke, and the average life expectancy for Canadians of the same age and sex[18,19]. For instance, a 50-year-old with a life expectancy of 25 more years (versus 30 years for the average Canadian) would be assigned a cardiovascular age of 55. Once the study was completed, this risk profile became freely available on the McGill Cardiovascular Health Improvement Program website at www.chiprehab.com.

All risk profiles were completed at the study coordinating center and mailed to physicians prior the next patient visit. At entry into the study, subjects randomized into the risk profile group were shown their absolute coronary risk. The relative risk was graphically summarized by comparing this risk to a representative sample of Canadians of the same age and sex using data from the Canada Heart Health Survey[20]. Finally, a copy of the profile was given to the patient to take home. Each subsequent profile compared the patient's current coronary risk with all profiles obtained at previous visits so that patients could follow their response to therapy.

Study Visits

The baseline visit occurred 2–4 weeks following screening, and treatment was initiated with the choice of statin and starting dose left to the investigator. Follow-up visits occurred at 3, 6, 9, and 12 months with a re-evaluation of lipids and safety parameters 2 to 4 weeks prior to each visit. Blood pressure was measured at each visit and physicians were free to initiate or modify antihypertensive medications as they felt appropriate. Although change in blood pressure was not the primary focus of the study, it was measured at each visit as per study protocol using the routine procedures developed in each physician's practice.

At each visit, investigators discussed the risk profile with profile subjects, while usual care subjects received routine care as practiced by their physician. To replicate the usual barriers to adherence, all medication was purchased at a pharmacy chosen by the patient. Drug costs were borne by patients using private insurance, public drug plans, or out-of-pocket.

The analyses herein focus primarily on those individuals whose blood pressure was above currently recommended targets. In Canada, hypertension guidelines recommend that blood pressure above 130/80 should be treated in patients with diabetes and the treatment threshold of 140/90 is recommended for all other adults. During the study, the 2001, 2003 Canadian guidelines and the JNC VI American guidelines were in effect[2,4]. Extrapolating from these three documents, we defined undiagnosed hypertension eligible for treatment as a blood pressure above target on at least three consecutive occasions during the six study visits over one year. Treated hypertension requiring additional therapy was defined as blood pressure above target on two or more consecutive visits.

Data Analysis

Hypertension treatment rates were compared among patients not at blood pressure targets who received a risk profile vs. usual care. There remained the possibility that between-physician differences could have an effect on treatment decisions[21]. Accordingly, a random effects logistic regression model was used to estimate the effect of the intervention compared to the control group after adjustment for between-physician variability[22]. Patient inclusion and randomization in this trial was based only on the presence of treatable dyslipidemia. We therefore also adjusted for potential confounders that might be associated with treatment including the average systolic and diastolic blood pressure levels prior to patients requiring treatment and the presence of diabetes or cardiovascular disease.

The primary clinical trial results demonstrated that the most important feature of the risk profile was showing subjects their cardiovascular age. A larger "age gap" (difference between cardiovascular age — chronologic age) was positively associated with reaching lipid targets[15]. We therefore completed similar analyses on the hypertensive patients and compared the blood pressure thresholds associated with intensifying treatment (increasing treatment for those already treated or starting treatment among previously untreated patients).

RESULTS

Blood Pressure Above Target

Among 3,053 patients with dyslipidemia, 2,631 completed the full 12-month follow-up, including 1,352 (51%) who did not have previously diagnosed hypertension, and 1,279 (49%) who had diagnosed hypertension and were on medication at entry into the study. The reasons for 366 individuals dropping out of the study have previously been described in detail[15]. None of these drop-outs were due to issues surrounding hypertension treatment. During 12 months of follow-up, 30% of previously undiagnosed individuals were eligible to start treatment while 69% of diagnosed hypertensive subjects were eligible for additional treatment. In the primary randomized trial, randomization resulted in two very comparable groups[15]. Comparing the patients requiring more intensive anti-hypertension treatment who received the risk profiles versus those assigned usual care, the baseline characteristics were also very similar (Table 1), despite the fact that randomization in the primary clinical trial focused only on the need to treat blood lipids. Among 410 undiagnosed hypertensive individuals eligible for treatment, 114 (28%) were eventually started on antihypertensive medication. For those 886 patients with treated hypertension who required additional therapy, 276 (31%) actually received it.

Effect of the Decision Aid

Among those patients who required more intensive antihypertensive treatment, 178 of 668 (27%) receiving usual care were appropriately treated compared to 212 of 629 (34%) who received the risk profile (Table 2). The 7% (95% CI 2% – 12%) absolute increase in appropriate treatment suggests that 14 patients had to receive a risk profile in order for one additional patient to be appropriately treated. Once treatment was intensified, the drop in blood pressure at the next visit averaged 13 mmHg compared to 5 mmHg among those who were not treated. Similar results were observed for initiating treatment among individuals without previously diagnosed hypertension or increasing treatment among those previously treated. Table 2 also presents the unadjusted effect of the risk profile (OR=1.40, 95% CI 1.11 – 1.78) or adjusted for between physician differences (OR=1.42, 95% CI 1.11 – 1.83) and potential confounders (OR=1.46, 95% CI 1.12 – 1.90).

The use of the coronary risk profile remained an independent determinant of starting or adjusting antihypertensive treatment among all patients eligible for more intensive treatment, among those without previously diagnosed hypertension and those with known hypertension. In these analyses, the coefficients for each investigator was the random effects factor, and we adjusted for the average systolic and diastolic blood pressure levels prior to patients requiring treatment according to guidelines. The presence of diagnosed cardiovascular disease or diabetes was also forced into the model to adjust for the different treatment strategies associated with these conditions.

To better understand how the risk profile results influenced treatment decisions, we compared the thresholds for intensifying blood pressure therapy among individuals in the risk profile and usual care groups. Compared to the usual care group, blood pressure was only slightly lower in the risk profile group (−1.1 mm) just prior to starting treatment (Table 3). However, the risk profile for individuals with prior CVD did not include an estimate of their cardiovascular age. Also, some

Table 1. Characteristics of Subjects Requiring More Intensive Antihypertensive Treatment*

	Requiring treatment initiation		Requiring treatment modification	
	Risk profile group (n=207)	Usual care group (n=203)	Risk profile group (n=421)	Usual care group (n=465)
Subject's age	56.0 (7.6)	55.8 (7.9)	58.2 (7.6)	58.3 (7.4)
Total cholesterol (mmol/L)	6.09 (1.01)	6.17 (0.96)	6.12 (1.05)	6.01 (1.00)
LDL cholesterol (mmol/L)	3.88 (0.85)	4.01 (0.83)	3.85 (0.83)	3.79 (0.83)
HDL cholesterol (mmol/L)	1.16 (0.29)	1.17 (0.29)	1.15 (0.30)	1.17 (0.29)
Total cholesterol/ HDL ratio	5.46 (1.30)	5.51 (1.34)	5.58 (1.49)	5.37 (1.28)
Body mass index (kg/m2)	31.4 (5.5)	31.5 (6.1)	32.1 (6.1)	32.4 (6.0)
Systolic blood ressure (mmHg)	143.3 (15.6)	143.6 (14.2)	145.9 (16.0)	145.1 (14.5)
Diastolic blood pressure (mmHg)	86.3 (9.3)	87.3 (8.6)	85.4 (9.5)	85.9 (9.0)
Female	31.4 %	27.1 %	39.4 %	34.0 %
Smoking	26.6 %	31.0 %	21.9 %	21.9 %
Cardiovascular disease	17.9 %	21.2 %	20.4 %	18.9 %
Diabetes	53.1 %	54.2 %	58.9 %	55.9 %

**Values represent means (SD) or proportion with the condition. There were no statistical significant differences in characteristics between the risk profile and usual care groups except for the CHL/HDL ratio among those requiring treatment modification (p<0.01)*

Table 2. Increased Likelihood of Initiating or Increasing Hypertension Treatment Among Patients Who Received a Risk Profile

	Risk profile	Usual care	Difference 95% (CI)	Unadjusted (fixed effects model) OR (95% CI)	Unadjusted (random effects model [a]) OR (95% CI)	Adjusted (random effects model[b]) OR (95% CI
Initiating or increasing treatment	33.8%	26.7%	7.1 (2.1–12.1)**	1.40 (1.11 – 1.78)	1.42 (1.11 – 1.83)	1.46 (1.12 – 1.90)
Initiating treatment	31.4%	24.1%	7.3 (−1.4–15.9)	1.44 (0.93 – 2.22)	1.44 (0.93 – 2.23)	1.78 (1.06 – 3.00)
Increasing treatment	34.9%	27.7%	7.2 (1.1–13.3)*	1.40 (1.05 – 1.86)	1.42 (1.06 – 1.92)	1.40 (1.03 – 1.91)

* $p<0.05$
** $p<0.01$
[a] *Random effects model adjusts for between physician differences*
[b] *Random effects model also adjusting for average systolic and diastolic blood pressure prior to requiring treatment, the presence of diabetes, and the presence of cardiovascular disease*

individuals without CVD had received a re-assuring profile where their cardiovascular age was less than or equal to their chronologic age ("age gap" ≤ 0). The age gap had previously been shown to be an important determinant of how the risk profile results impacted on lipid therapy[15]. Accordingly, similar sub-group analyses were preformed on the hypertension treatment results. Treatment was initiated at a higher threshold (5 mm higher) among risk profile patients who were not provided with their cardiovascular age due to the presence of prior CVD. Similarly, there was virtually no difference in the systolic blood pressure treatment threshold between the usual care and risk profile patients (0.4 mm lower) when the age gap was favourable (≤ 0). However, lower blood pressure treatment thresholds were observed when the age gap was >0 (3.2 mm lower). Results among those with a positive age gap were also stratified by the presence of diagnosed diabetes to control for the different treatment goals and one still observed a more pronounced effect among those with diabetes (3.4 mm lower) and those without (3.1 mm lower). Similar trends were observed for diastolic blood pressure. These analyses suggest the use of the risk profile, when the age gap was >0, may have lowered the threshold for intensifying treatment. However, the confidence intervals surrounding the observed differences were wide.

CONCLUSIONS

This secondary analysis of the CHECK-UP study demonstrates that using a coronary risk profile to improve the treatment of dyslipidemia may also have a positive spill-over effect on the management of hypertension. Compared to patients randomized to usual care, patients who were shown their risk profiles were more likely to receive appropriate anti-hypertensive treatment. The previously published, primary results of the study demonstrated a significant "dose response" effect where the impact of the risk profile was greatest among those individuals with the largest "age gap" (difference between their chronologic age and the calculated cardiovascular age) [15]. Although the number of observations was much smaller when anti-hypertensive therapy was examined, the spill-over effect of the profile also appeared to be restricted to those high risk individuals with an age gap >0.

The frequency of poor control in the CHECK-UP study was similar to that reported in other surveys [6–11]. This was despite the fact that the patients who were evaluated were enrolled in a coronary risk reduction trial albeit one where the primary focus was blood lipid therapy. For instance, among those with treated hypertension, 69% were above target on at least two consecutive visits. A two-year review of blood pressure management among hypertensive men followed in Veteran Affairs sites in New England between 1990–1995 found that during 5,682 clinic visits, hypertension was not well controlled (<140/90) 73% of the time[7]. Clearly there remained substantial room for improvement in both patient cohorts.

The impact of the risk profile was consistent with a similar randomized trial by Hall et al. evaluating the usefulness of attaching a patient's New Zealand coronary risk score to their charts[23]. Among 323 patients with type 2 diabetes, the overall

Table 3. Mean Blood Pressure Thresholds for Intensifying Anti-Hypertensive Therapy in Usual Care and Risk Profile Groups

		Study arms		
		Risk profile	Usual care	Diff (95% CI)
All patients	n=	212	178	
	SBP	151.0	152.1	1.1 (−1.9–4.1)
	DBP	87.4	87.7	0.3 (−1.6–2.3)
Patients with CVD	n=	46	35	
	SBP	156.6	151.7	−5.0 (−12.3–2.4)
	DBP	87.2	84.1	−3.0 (−8.0–2.0)
Patients without CVD	n=	166	143	
	SBP	149.4	152.2	2.8 (−0.5–6.0)
	DBP	87.5	88.6	1.1 (−0.9–3.2)
Age gap ≤ 0	n=	24	15	
	SBP	152.7	153.1	0.4 (−6.5–7.3)
	DBP	86.4	87.8	1.4 (−3.6–6.4)
Age gap > 0	n=	142	128	
	SBP	148.9	152.1	3.2 (−0.4–6.8)
	DBP	87.6	88.7	1.1 (−1.2–3.3)
With diabetes	n=	93	87	
	SBP	147.9	151.3	3.4 (−0.9–7.6)
	DBP	85.0	87.1	2.1 (−0.6–4.9)
Without diabetes	n=	49	41	
	SBP	150.6	153.7	3.1 (−3.6–9.8)
	DBP	92.7	92.1	−0.6 (−3.9–2.7)

Age gap is defined as the difference between the patient's "cardiovascular age" and their chronologic age (see Methods for more details). Cardiovascular age was not provided to those patients with previously diagnosed CVD

results of the study were not significant. However, among those calculated to be at high risk (>20% five-year risk) a significant improvement in treatment with antihypertensive and lipid-lowering drugs was noted. Parkes et al. also recently demonstrated that smoking cessation can be enhanced when an individual's lung function is assessed and their calculated "lung age" is presented to them[24].

Physician behaviour surrounding cardiovascular disease prevention and hypertension therapy is a complicated issue. A systematic review of quality improvement strategies for hypertension management by Walsh et al.[25] identified 44 studies where the median improvement in systolic and diastolic pressure (compared to control patients) were 4.5 and 2.1 mmHg, respectively. Another review by Tu and colleagues identified 12 randomized controlled trials of physician education interventions to improve the management and follow-up of hypertension[26]. An actual improvement in blood pressure control was observed in only three studies. In one of these studies, by Hetlevik et al., a computer-based clinical decision support system and physician education program, improved blood pressure control by an additional 1 to 2 mmHg[27]. A second study by Montgomery et al., using a coronary risk chart did result in a lower mean systolic blood pressure (−4.6 mmHg) compared to usual care, but did not improve overall risk reduction[28].

A Cochrane review by Schroeder et al. concluded that educational interventions evaluated in randomized trial have rarely demonstrated a change in either patient behaviour or blood pressure control[29]. The reviewers recommended that future interventions should take into account patients' views while enhancing shared decision-making between patient and health care professional. More active communication between patient and physician[30] is one possibility for the results presented herein. An earlier study demonstrated that use of a similar risk profile was associated with patients spending more time discussing their results with their physicians and family members[31].

The potential weaknesses of this study must be recognized. Both physicians and patients were focusing primarily on the treatment of dyslipidemia to reduce coronary risk in a clinical trial. It is therefore not clear to what extent these results reflect current treatment patterns observed outside of a research study. In the absence of long-term follow-up data, it remains unclear whether more intensive hypertension treatment eventually resulted in better blood pressure control. On the other hand the study has a number of strengths. The generalizability of the findings was enhanced given that data were collected longitudinally from a broad sample of primary care practice settings across the country. The cost of lipid and blood pressure medication and the effort to obtain it also reflected patient care as currently practiced under a national health care plan. As the control of hypertension was not the primary focus of this study, the treatment patterns observed among patients were not driven by a study protocol, but rather by usual clinical practice. Accordingly the spill-over effect of the risk profile beyond the primary lipid endpoints could be assessed.

In conclusion, providing patients and their physicians with a coronary risk profile increased the likelihood of appropriately treating hypertension. This suggests that global risk assessment may help physicians and patients to look beyond a single risk factor. Cardiovascular risk assessment decision aids should be further evaluated in a randomized trial of hypertension therapy.

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Conflict of Interests: *Dr. Steven Grover, Dr. Ilka Lowensteyn, Mr. Mohammed Kaouache, Mr. Louis Coupal, and Ms. Sylvie Marchand have received research grants from Pfizer, Sanofi Aventis, and AstraZeneca. Dr. Grover has received speaker honoraria from Pfizer, Sanofi Aventis, and Orynx. As well, Dr. Grover has either been a consultant or participated on an advisory board for AstraZeneca, Sanofi Aventis, Pfizer and Merck. Dr. Ghislain Boudreau has ownership interests and is a full-time employee within the medical division of Pfizer Canada Inc. Dr. Lawrence Joseph has no conflict of interest.*

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APPENDIX 1

Table 4 shows the participants in the CHECK-UP study group.

Table 4. The CHECK-UP Study Group

Participants	Participants	Participants
Dr. Lorne W Adams	Dr. Mario Côté	Dr. John P Hopkins
Dr. Ronald Akhras	Dr. Donald E Craig	Dr. Anita S Hunt
Dr. Mohamed M Ali	Dr. Thomas R Crawford	Dr. Antony M Irving
Dr. Cathy V Andrew	Dr. Wesley S Cutbush	Dr. Wesley D Jackson
Dr. Donald M Andrew	Dr. Oliver A David	Dr. David HC James
Dr. Haig Ashikian	Dr. Guy Deslauriers	Dr. Peter Jechel
Dr. David Attwell	Dr. Charles Dewar	Dr. Anthony F Jeraj
Dr. Abdoulaye Bah	Dr. Marcel Déziel	Dr. Thomas E Johnson
Dr. Denis A Beaulieu	Dr. Ripple Dhillon	Dr. Jean-François Julien
Dr. Margaret H Bennett	Dr. Jean D Dion	Dr. Pierre Julien
Dr. Samuel Bergman	Dr. Leonard Direnfeld	Dr. Bharat B Kalra
Dr. Ranbir S Bhatia	Dr. Wayne B Domanko	Dr. Nicholas Karellis
Dr. Gunvant S Bhatt	Dr. Bernard Dufour	Dr. Martin L Kates
Dr. Krzysztof W Bienkowski	Dr. Thomas H Echlin	Dr. Ian K Kendal
Dr. Clair Biglow	Dr. Mark Essak	Dr. Bertram W King
Dr. David BI Birbrager	Dr. Ronald G Esterbauer	Dr. Judy Komosky
Dr. Gregory L Black	Dr. Brian Fagan	Dr. Arthur M Kushner
Dr. Cifford P Blais	Dr. Roland Faucher	Dr. Donald Lafortune
Dr. Richard Blanchet	Dr. Alcantro B Fernandez	Dr. Roch Lambert
Dr. Denys Blouin	Dr. George F Fitzpatrick	Dr. Yves P Langlois
Dr. Raynald C Boily	Dr. David L Fleck	Dr. Brodie Lantz
Dr. Jacques Boisselle	Dr. Curtis S Folkerson	Dr. Hélène Laporte
Dr. Serge Boucher	Dr. Anne H Fong	Dr. François Laurendeau
Dr. Jean Bouffard	Dr. Dennis HG Forrester	Dr. Brian W Laursen
Dr. Jean Bouthillier	Dr. Carl Fournier	Dr. John Law
Dr. Christiane Bovo	Dr. Norman L Fox	Dr. Michael Leckie
Dr. Boris W Boyko	Dr. Évelyne Fraser	Dr. Frank R Lee
Dr. Richard Brassard	Dr. Robert C Frechette	Dr. Marc-Frédérick Lee
Dr. Jeannot Breton	Dr. Maude Gagnon	Dr. Cheuk-Hon Li
Dr. Gilles D Brousseau	Dr. Eamon N Gamble	Dr. Shao-Jin Li
Dr. Gerald Brown	Dr. Edward Gee	Dr. Pierre Liboiron
Dr. Jerzy T Brzeski	Dr. Roland J Genge	Dr. Hanson K. Lo
Dr. Brian J Buckley	Dr. Michael A Geoghegan	Dr. Lydia CL Lo
Dr. Al-Beruni S Buckridan	Dr. Kamil Ghali	Dr. Graham J Loeb
Dr. William A Buckton	Dr. Stuart R Glaser	Dr. Benoit Loranger
Dr. Brent E Bukovy	Dr. Bronte L Golda	Dr. Terrence Magennis

(*continued on next page*)

Table 4. (continued)

Dr. George Burwell	Dr. Serge Goulet	Dr. Thomas Maguire
Dr. Ashok K Chadha	Dr. Moonsamy Govender	Dr. Lorne A Marsh
Dr. Richard J Champoux	Dr. William C Gracey	Dr. Azaria Marthyman
Dr. Hari S Chana	Dr. Robert D Graham	Dr. Peter D McPhedran
Dr. Pierre Charbonneau	Dr. Russell Grimwood	Dr. Upender K Mehan
Dr. Tak-Kee Cheung	Dr. Andrée A Guay	Dr. Pravinsagar Mehta
Dr. John F Chiu	Dr. Magdi Y Habra	Dr. Shamsh Y Merali
Dr. Pan C Chow	Dr. Brian P Hadley	Dr. Denis Métivier
Dr. Walter Chow	Dr. Darlene Hammell	Dr. Michel Meunier
Dr. Margaret A Churcher	Dr. Velizar A Harizanov	Dr. Maurice Milner
Dr. John M Collingwood	Dr. Bruce A Herman	
Dr. Donald Collins-Williams	Dr. David W Hillier	
Dr. Angelos Costaris	Dr. Michael SC Ho	
Dr. Kenneth A Mitton	Dr. Brian S Swarbreck	
Dr. Martin Model	Dr. John P Taliano	
Dr. Gloria M Mok	Dr. Jonny Tam	
Dr. Alan Munroe	Dr. Margaret KH Tao	
Dr. Salma B Murji	Dr. Alain Tardif	
Dr. Kapila Narang	Dr. Ivor Teitelbaum	
Dr. Derek S Nesdoly	Dr. Allison M Theman	
Dr. Dung P Nghiem	Dr. Lyne Thériault	
Dr. Claire M Nunes-Vas	Dr. Nicole Thibault	
Dr. Richard Nuttall	Dr. Morris E Trager	
Dr. Paul F O'Brien	Dr. Holtby M Turner	
Dr. Helen Olijnik	Dr. Steven L Turner	
Dr. Chelvi AM Pandian	Dr. Douglas Tweel	
Dr. Marilyn F Paterson	Dr. Richard H Tytus	
Dr. Claude Patry	Dr. Kandiah Vaithianathan	
Dr. Peter Petrosoniak	Dr. Alain Valiquette	
Dr. André Poisson	Dr. Phillip W Van Der Merwe	
Dr. Charles Potter	Dr. Trevor TC Vu	

Table 4. (continued)

Dr. David G Pow	Dr. Robert J Wahby
Dr. Gerard Quinn	Dr. Lyle H Waldman
Dr. Salim M Quraishi	Dr. Paul E Walsh
Dr. Robert Ramsey	Dr. Marvin Waxman
Dr. John C Rea	Dr. Ronald S Weiss
Dr. Patrick A Renchko	Dr. Rhonda Wilansky
Dr. Marcel Reny	Dr. John S Wilczynski
Dr. Cyril Riche	Dr. Bryan E Williams
Dr. Brian D Ritchie	Dr. Sing Man Wu
Dr. Julie Ross	Dr. Stephen TW Wu
Dr. Robert J Roy	Dr. Jack KP Yeung
Dr. Herbert W Sacks	Dr. David KW Yip
Dr. Paul Salciccioli	Dr. Paul CK Yong
Dr. David Saul	Dr. Michael Zigman
Dr. Georgia Savvidou	
Dr. Martin Shack	
Dr. Ronald J Smith	
Dr. Salim Somani	
Dr. Peter A Souchen	
Dr. R George H Southey	
Dr. Nigel Spencer	
Dr. John S Spiers	
Dr. Joseph M Stander	
Dr. Michel St-Onge	
Dr. Jack Sussman	

APPENDIX 2

Table 5 shows the members of the scientific advisory board.

Table 5. Scientific Advisory Board

Board members
Dr. Brian Gore
Dr. Steven Grover
Dr. Lawrence Joseph
Dr. Lyne Lalonde
Dr. Ruth McPherson
Dr. John Stewart