CVD risk calculation

Cardiovascular disease (CVD) is the most common cause of death in Alberta, accounting for nearly one third (31%) of the overall deaths (1). The majority (90%) of the CVD cases are caused by modifiable risk factors. These factors include tobacco smoking, hypertension, hyperlipidemia, diabetes, physical inactivity, high fat diet and obesity (2).

Despite the risks associated with the major CVD risk factors and the treatment advancement, their prevalence is still substantial in North America (3). Treatment gaps were also reported amongst such factors (4). Al Hamarneh and colleagues (2012) reported that almost 50% of the community dwelling patients with type 2 diabetes were not at their HbA1c target (5). Leiter and colleagues (2013) reported that almost half of the patients with type 2 diabetes did not achieve their HbA1c or cholesterol target, slightly more than one third achieved their blood pressure targets and only 13% achieved the composite triple target (6).

The guidelines recommend using cardiovascular risk assessment equations to guide CVD prevention and management (7). Despite being recommended by the guidelines, it has not been integrated in the clinicians' daily routine; in fact the majority of the patients attending physicians' clinics reported that they have never had a cardiovascular risk assessment (7). This indicates the need for new avenues for the patients to get their cardiovascular risk assessed.

Community pharmacists are frontline primary healthcare professionals who see patients with chronic diseases more frequently than family physicians (8); as such they are well positioned to identify patients at high risk for CVD, determine their CVD risk and assist in their disease management. The efficacy of pharmacists' intervention in chronic disease has been well demonstrated in the literature (9-14).

How do I calculate the CVD risk?

Risk calculation allows the patient to better understand his/her individual risk factors and the degree of risk associated with each of the factors. It also can be helpful in encouraging medication adherence and lifestyle adjustment.

Different equations are available for calculating cardiovascular risk which is the primary outcome for this study. The following equations are going to be used in the study:

- Framingham (15) (for patients with CKD and patients at high CVD risk (Framingham risk score >20%)
- UKPDS (16) (for patients with diabetes)
- International model to predict cardiovascular disease (17) (for patients with a prior CVD event)

Clinical and demographic information should be collected from the patient in order to calculate his/her cardiovascular risk. This information will vary according to which the risk engine used.

An online system which helps the pharmacist to calculate the patient's cardiovascular risk will be made available for all the participating pharmacists.

Detailed information about the way of calculating cardiovascular risk using different equations is provided below:

Framingham requires collecting the following information:

- Age

- Gender

- Total cholesterol and HDL

- Systolic blood pressure and whether or not it is being treated

- Smoking status

- Diabetic status

After collecting this information the following score sheet should be used to assign scores to each risk factor based on Gender (15).

Males

Points	Age, y	HDL	Total Cholesterol	SBP Not Treated	SBP Treated	Smoker	Diabetic
−2		60+		<120			
−1		50–59					
0	30–34	45–49	<160	120–129	<120	No	No
1		35–44	160–199	130–139			
2	35–39	<35	200–239	140–159	120–129		
3			240–279	160+	130–139		Yes
4			280+		140–159	Yes	
5	40–44				160+		
6	45–49						
7							
8	50–54						
9							
10	55–59						
11	60–64						
12	65–69						
13							
14	70–74						
15	75+						
Points allotted							Total

Females

Points	Age, y	HDL	Total Cholesterol	SBP Not Treated	SBP Treated	Smoker	Diabetic
−3				<120			
−2		60+					
−1		50–59			<120		
0	30–34	45–49	<160	120–129		No	No
1		35–44	160–199	130–139			
2	35–39	<35		140–149	120–129		
3			200–239		130–139	Yes	
4	40–44		240–279	150–159			Yes
5	45–49		280+	160+	140–149		
6					150–159		
7	50–54				160+		
8	55–59						
9	60–64						
10	65–69						
11	70–74						
12	75+						
Points allotted							Total

Framingham risk engine score sheet

After assigning scores to different risk factors, those scores should be added to get the total points which then should be matched with the 10 year cardiovascular risk (%) based on the gender using the following tables

Males

Points	Risk, %
≤−3 or less	<1
−2	1.1
−1	1.4
0	1.6
1	1.9
2	2.3
3	2.8
4	3.3
5	3.9
6	4.7
7	5.6
8	6.7
9	7.9
10	9.4
11	11.2
12	13.2
13	15.6
14	18.4
15	21.6
16	25.3
17	29.4
18+	>30

Females

Points	Risk, %
≤−2	<1
−1	1.0
0	1.2
1	1.5
2	1.7
3	2.0
4	2.4
5	2.8
6	3.3
7	3.9
8	4.5
9	5.3
10	6.3
11	7.3
12	8.6
13	10.0
14	11.7
15	13.7
16	15.9
17	18.5
18	21.5
19	24.8
20	28.5
21+	>30

If the patient is between 30-59 and he/she has a first degree relative who had an early CVD (before 55 in men and 65 in women), his/her 10 year cardiovascular risk should be doubled (18).

If the total cholesterol and HDL values are not available, BMI can be used to calculate the CVD risk using a simple model with office-based non-laboratory predictors based on the following gender specific score sheets (15):

Male

POINTS	Age	BMI	SBP Not Treated	SBP Treated	Smoker	Diabetic	
-2			<120				
-1							
0	30-34	<25	120-129	<120	NO	NO	
1		25-<30	130-139				
2	35-39	≥30	140-159	120-129			
3			160+	130-139		YES	
4				140-159	YES		
5	40-44			160+			
6							
7	45-49						
8	50-54						
9							
10	55-59						
11	60-64						
12							
13	65-69						
14	70-74						
15	75+						TOTAL POINTS
Points Allotted							

Female

POINTS	Age	BMI	SBP Not Treated	SBP Treated	Smoker	Diabetic	
-3			<120				
-2							
-1				<120			
0	30-34	<25	120-129		NO	NO	
1		25-<30	130-139				
2	35-39	≥30		120-129			
3			140-149	130-139			
4			150-159		YES		
5	40-44		160+	140-149		YES	
6	45-49			150-159			
7							
8	50-54			160+			
9							
10	55-59						
11	60-64						
12	65-69						
13							
14	70-74						TOTAL POINTS
15	75+						
Points Allotted							

After assigning scores to different risk factors, those scores should be added to get the total points which then should be matched with the 10 year cardiovascular risk (%) based on the gender using the following tables

Male

POINTS	RISK	POINTS	RISK	POINTS	RISK
-5 or less	Below 1%	**3**	4.0%	**11**	15.7%
-4	1.1%	**4**	4.7%	**12**	18.5%
-3	1.4%	**5**	5.6%	**13**	21.7%
-2	1.6%	**6**	6.7%	**14**	25.4%
-1	1.9%	**7**	8.0%	**15**	29.6%
0	2.3%	**8**	9.5%	**16+**	Above 30%
1	2.8%	**9**	11.2%		
2	3.3%	**10**	13.3%		

Female

POINTS	RISK	POINTS	RISK	POINTS	RISK
-2 or less	Below 1%	**6**	3.4%	**14**	11.6%
-1	1.0%	**7**	3.9%	**15**	13.5%
0	1.1%	**8**	4.6%	**16**	15.6%
1	1.5%	**9**	5.4%	**17**	18.1%
2	1.8%	**10**	6.3%	**18**	20.9%
3	2.1%	**11**	7.4%	**19**	24.0%
4	2.5%	**12**	8.6%	**20**	27.5%
5	2.9%	**13**	10.0%	**21+**	Above 30%

If the patient is between 30-59 and he/she has a first degree relative who had an early CVD (before 55 in men and 65 in women), his/her 10 year cardiovascular risk should be doubled (18).

Please use the simple model with office-based non-laboratory predictors calculator ONLY if the lipid panel is not available. ONCE the lipid panel is available please recalculate the CVD risk using the total cholesterol and HDL as indicated above BEFORE MAKING ANY CLINICAL DECISION.

Based on the 10 year cardiovascular risk, the patient can be categorized into the following groups:

- Low risk if 10 year cardiovascular risk is less than 10%

- Intermediate risk if 10 year cardiovascular risk is between 10 and 19%

- High risk if 10 year cardiovascular risk is 20% or higher (15)

UKPDS requires collecting the following information:

- Age

- Gender

- Diabetes duration

- HbA1c

- Systolic blood pressure

- Total Cholesterol and HDL

- Atrial fibrillation

- Ethnicity (White/Other, African-Caribbean, Asian-Indian)

- Smoking status (16)

After collecting this information the following parameters will be used as the following:

Parameter	Interpretation	Estimate	95% confidence interval
q_0	Intercept	0.0112	0.0082–0.014
β_1	Risk ratio for one year of age at diagnosis of diabetes	1.059	1.05–1.07
β_2	Risk ratio for female sex	0.525	0.42–0.63
β_3	Risk ratio for Afro-Caribbean ethnicity	0.390	0.19–0.59
β_4	Risk ratio for smoking	1.350	1.11–1.59
β_5	Risk ratio for 1% increase in HbA_{1c}	1.183	1.11–1.25
β_6	Risk ratio for 10 mmHg increase in systolic blood pressure	1.088	1.04–1.14
β_7	Risk ratio for unit increase in logarithm of lipid ratio	3.845	2.59–5.10
d	Risk ratio for each year increase in duration of diagnosed diabetes	1.078	1.05–1.11

$q = q_0 * B1^{(Age-55)} * B2^{(female)} * B3^{(African\ Caribbean)} * B4^{(Smoker)} * B5^{(HbA1c-6.72)} * B6^{(SysBP-135.7)/10} * B7^{\ln(lipid\ ratio)-1.59}$

Then the 10 year CHD risk is:

$R(20) = 1-\exp\{-q[(1-d^{10})/1-d)]\}$ (16).

15% CHD risk using UKPDS calculator is equal to 20% CVD risk (19).

International model to predict cardiovascular disease requires collecting the following information:

- Age

- Gender

- Smoking status

- Diabetic status

- BMI < 20 kg/m^2

- Number of vascular beds affected (one, two or three)

- CV event (Myocardial infarction, cerebrovascular disease, cardiovascular death) in past year (Yes, No)

- Congestive heart failure (Yes, No)

- Statin therapy

- ASA therapy

- Ethnicity (North American/Western European/Other, Eastern Europe/Middle East, Japanese/Australian) (17).

After collecting this information the following score sheet will be used to assign scores to each risk factor.

Step	Factor	Next CV event: factors and points	CV event points	CV death: factors and points	CV death points
1	Sex	Man Woman 1 0		Man Woman 1 0	
2	Age, years	20–24 25-29 30-34 35-39 40–44 45-49 50–54 0 1 2 3 4 5 6 55–59 60-64 65-69 70–74 75-79 80–84 85-89 7 8 9 10 11 12 13		20–24 25-29 30-34 35-39 40–44 45-49 50–54 0 1 2 3 4 5 6 55–59 60-64 65-69 70–74 75-79 80–84 85-89 7 8 9 10 11 12 13	
3	Smoking	No Yes 0 2		No Yes 0 1	
4	Diabetes mellitus	No Yes 0 2		No Yes 0 2	
5	BMI < 20 kg/m^2	No Yes 0 2		No Yes 0 2	
6	Number of vascular beds	One Two Three 2 4 6		One Two Three 1 2 3	
7	CV event in past year	No Yes 0 2		No Yes 0 1	
8	Congestive heart failure	No Yes 0 3		No Yes 0 4	
9	Atrial fibrillation	No Yes 0 2		No Yes 0 2	
10	Statin therapy	No Yes 0 –2		No Yes 0 -1	
11	ASA therapy	No Yes 0 -1		No Yes 0 -1	
12	Eastern Europe or Middle East	No Yes 0 2		No Yes 0 1	
13	Japan or Australia	No Yes 0 -2		No Yes 0 -3	
14		Next CV event points total		CV death points total	

After assigning scores to different risk factors, those scores should be added to get the total points which then should be matched with the 20 month cardiovascular risk (%) using the following tables

Next CV event points	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
20-month risk of next CV event, %	<1	1	1.2	1.4	1.6	1.9	2.2	2.5	3	3.5	4	4.7	5.4	6.3	7.3	8.5	9.8	11	13
Next CV event points	19	20	21	22	23	24	25	26	27	28	≥29								
20-month risk of next CV event, %	15	17	20	23	26	30	34	38	43	48	>50								
CV death points	0-8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	≥26
20-month risk of CV death, %	<1	1.1	1.4	1.8	2.3	3	3.8	4.9	6.2	7.9	10	13	16	20	25	30	37	45	>50

All patients with previous CVD event(s) are considered to be at high CVD risk.

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