Health Canada Santé Canada

Your health and safety… our priority. *Votre santé et votre sécurité… notre priorité.*

Air pollution and cardiovascular health: Is it relevant to cardiac rehabilitation, and how can it be incorporated?

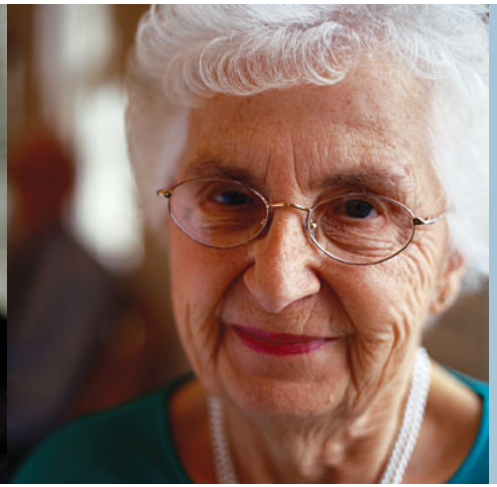
CACR 23rd Annual Meeting and Symposium

Montreal, October 2013

Dr Alan Abelsohn MBChB, CCFP, FCFP

Department of Family and Community Medicine and Dalla Lana School of Public Health, University of Toronto

Healthy Environments and Consumer Safety Branch, Health Canada



Canada

Conflict of Interest

Health Canada

Learning Objectives

1. Summarize the evidence base linking air pollution with adverse cardiovascular health impacts
2. Recognize specific cardiovascular diseases that are impacted by air pollution exposure
3. Apply the Air Quality Health Index as a counseling tool in patient care
4. Counsel their cardiovascular patients to reduce the adverse health impacts related to air pollution exposure

How many of you……..??

Case

- You assess 14 year-old, Judy, in ER with shortness of breath; worsening of her asthma
- PMH: She has had difficult to control asthma; on
  - Fluticasone/ Salmeterol Combination diskus; Salbutamol prn
- She is a track athlete, and was training yesterday. She does not smoke, and no-one at home smokes
- What are the possible triggers for the worsening of her asthma?
- Could outdoor air pollution be a trigger that is exacerbating her asthma?

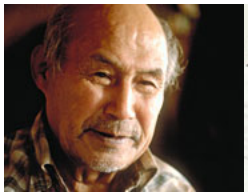
Could outdoor air pollution be a trigger that is exacerbating her asthma?

AQHI- asthma health care utilization

"each unit increase AQHI is highly and significantly associated with an increase in asthma ED visits"

AQHI	Outpatient claims
3	2278
10	3330

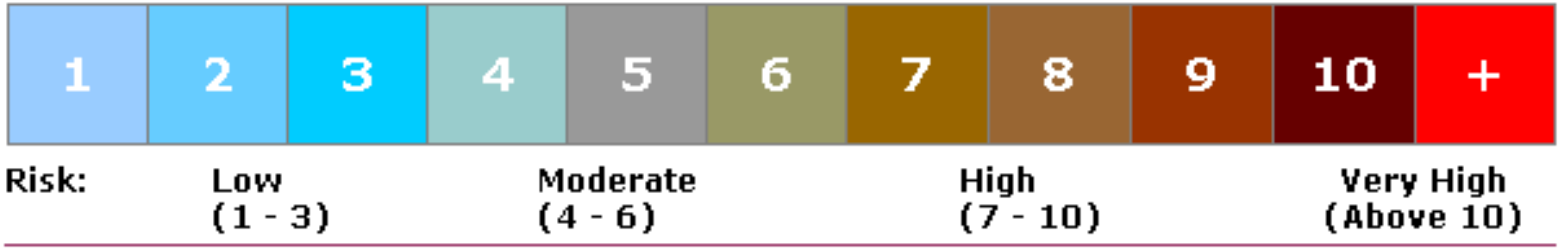
To, T. Env Health Perspect. 2013




Case

What can she, and you as her physician, do about it?

- Air Quality Health Index (AQHI)



Case

- You assess 61 year-old male in ER with atrial fibrillation x 4hrs
- PMH: Hypertension; on Ramipril 5mg and HCT 12.5mg od; non-smoker
- He is a runner, and was training this morning.
- Is air pollution a possible trigger for his arrhythmia?

- **Air pollution and health**
  - **Air pollution and cardiovascular disease**
- Who is at risk?
- What is the AQHI?
  - Scientific basis
  - Health messages
- Clinical practice guidelines and clinical application

Short-term exposure

- Exacerbation of pre-existing respiratory disease
  - asthma
  - COPD
- Exacerbation of pre-existing CVS disease
  - ischemia
  - heart failure
  - Arrhythmia
  - Ischemic stroke
- Increased Hospitalization/ ED visits

Long-term exposure

- Increased mortality
- Increased incidence of Ca lung; pneumonia
- Development of atherosclerosis
- Pregnancy effects
- New onset of asthma (McConnell EHP 2010, Dell Epidemiology 2008)
- Reduced lung function growth (Gauderman NEJM 2004)

National Illness Costs of Air Pollution. CMA 2008

	Canada 2008
Acute premature deaths	2,682 (21,000)
Hospital admissions	10,966
ED visits	92,690
Minor illnesses	22,542,500
Doctors office visits	623,369
Costs	$ 8 billion

Heart and Stroke Foundation:
Report Card on Canadians' Health 2008

Air pollution is now a year-long threat to the heart health of Canadians

Approx 6,000 additional deaths in Canada because of exposure to air pollution;
69% due to cardiac and cerebro-vascular disease

> "It's ironic that people who are recovering from − or are trying to prevent − heart disease by being physically active may actually be exposing themselves to more risk on bad air days if they head outdoors to be active."
> Dr Beth Abramson
> Director of the Cardiac Prevention and Rehabilitation Centre & Women's Cardiovascular Health in the Division of Cardiology at St. Michael's Hospital.

Heart and Stroke Foundation:
Report Card on Canadians' Health 2008

Survey of 1134 Canadians:

•63% believe air quality has a major effect on health

•61% do **not** let smog advisories affect what they do outdoors.

Air Pollution disease link:

- •82% Respiratory diseases
- •34% Cancer
- **•13% Heart disease**

Circulation
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AHA Scientific Statement
Particulate Matter Air Pollution and Cardiovascular Disease
Brook RD. Circulation. 2004; 109: 2655-2671

Particulate matter air pollution and cardiovascular disease:
An update to the scientific statement from the American Heart Association.
Brook, RD. Circulation 2010;121(21):2331-78

New Insights Into Pollution and the Cardiovascular System : 2010 to 2012
Gold DR. Circulation. 2013;127:1903-1913

Circulation
JOURNAL OF THE AMERICAN HEART ASSOCIATION
American Heart Association®
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Short term exposure

- Affects people with pre-existing disease
- Linear effects; no threshold
- ^ Mortality and Hospitalization

  - Ischemic Heart Disease
  - Heart failure
  - Arrhythmias and cardiac arrest
  - Ischemic stroke and TIA
  - PVD

Brook RD; Circulation. 2010

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Long term exposure

- ^ Risk CVS mortality
  - ? summation of acute effects
  - ? Incremental due to ^ atherosclerotic development
- RR long term studies > acute exposures
- Reductions in PM reduce mortality over a few years

Brook RD; Circulation. 2010

AP and Heart failure

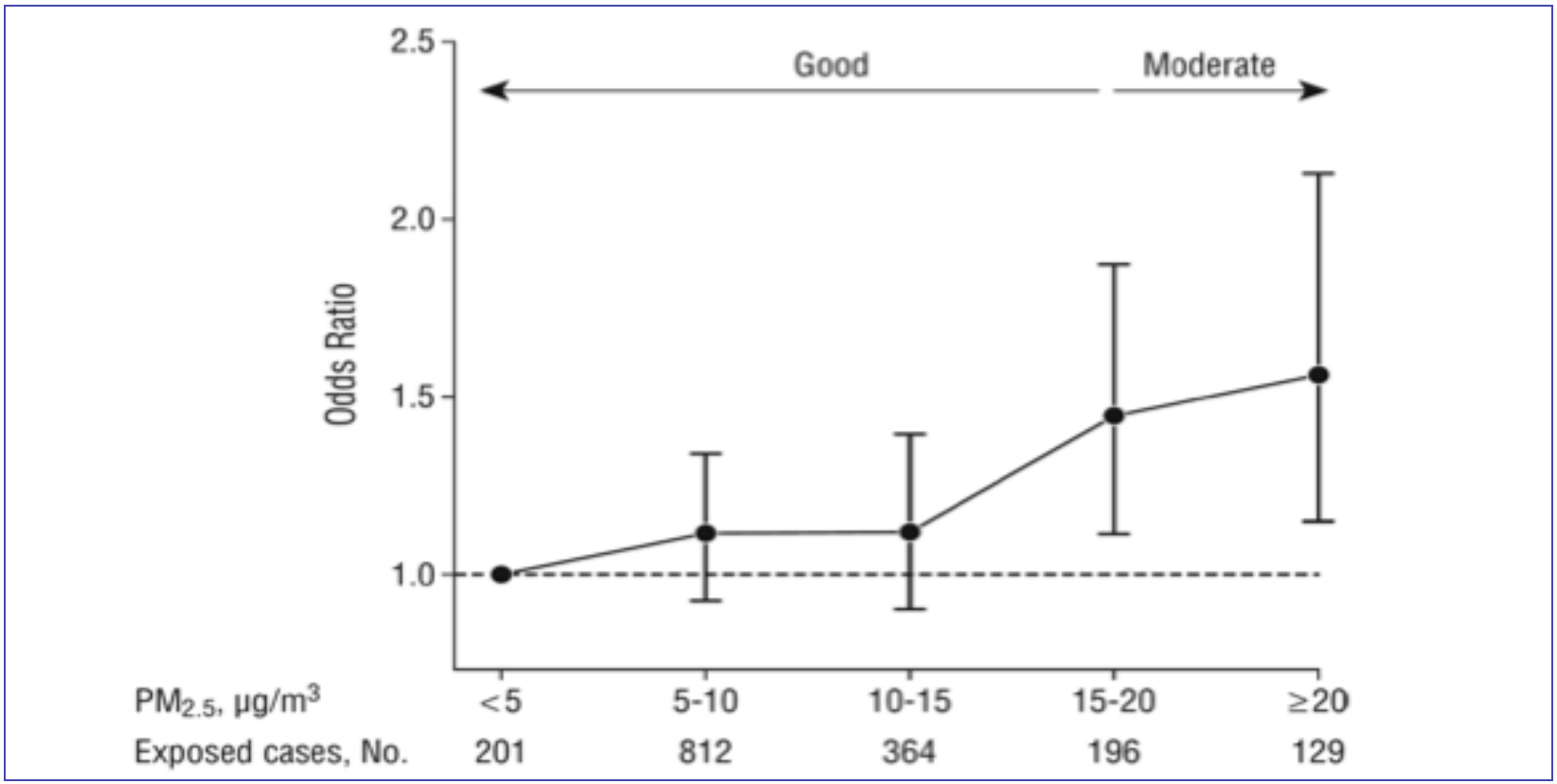
- Systematic review and meta-analysis (Shah. Lancet 2013)

- Robust and clear temporal associations between exposure to air pollutants and
  - heart failure hospitalisations
  - heart failure mortality

- Decompensation due to
  - ^ systemic BP
  - Vasoconstriction
  - arrhythmias

Shah A. Lancet 2013;382:1039-48

OR Ischemic Stroke - PM2.5 in prev 24 hrs



Wellenius. Arch Intern Med. 2012

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Mechanisms

PM in pulmonary tree affect CVS system:

1. Systemic Inflammation/ oxidative stress
2. Alter autonomic balance
3. Direct effects on vasculature by PM reaching circulation

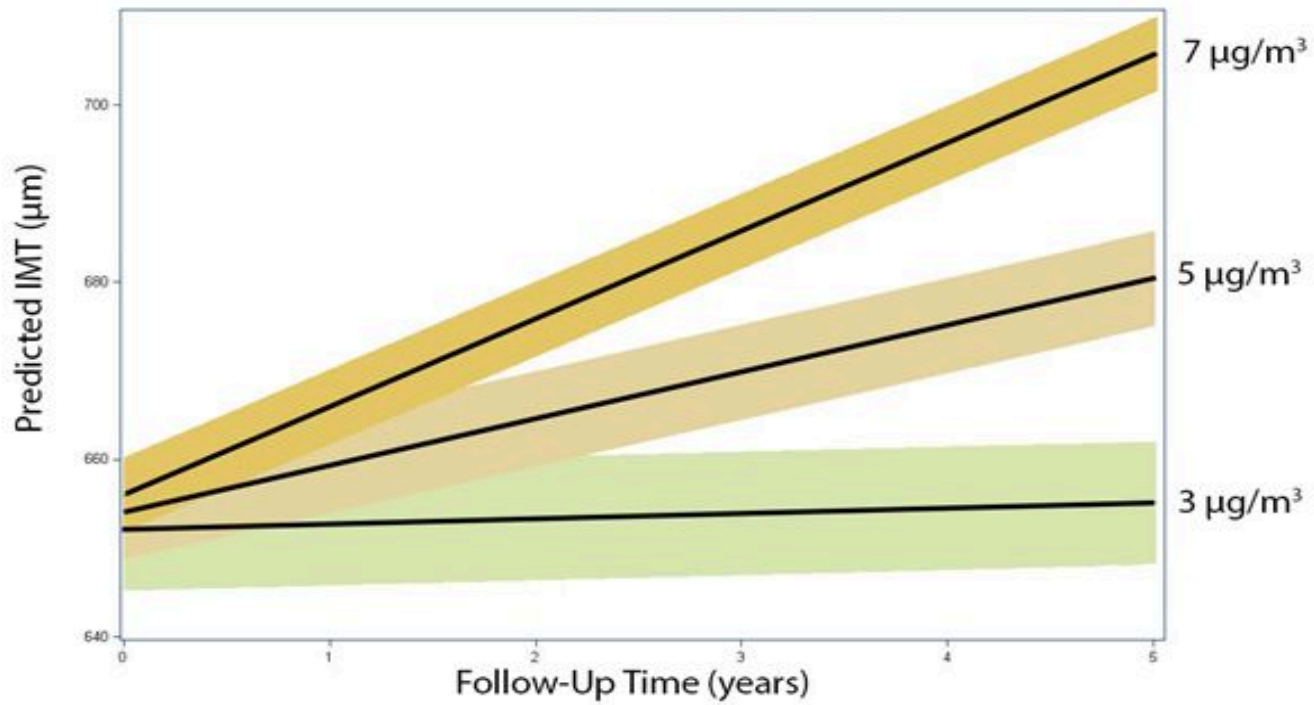
Which then triggers:

- Acute arterial vasoconstriction
- Systemic and pulmonary BP responses
- Endothelial dysfunction
- Arrhythmias
- Pro-thrombotic effects

Long term exposure enhances genesis of atherosclerosis

Brook RD; Circulation. 2010

CIMT (Intima-Medial Thickness) over time with residential PM 2.5 exceeding city average (data from MESA)



Adar S. PLoS MED, April 2013

Is Particlate Matter (PM) associated with adverse cardiac responses In patients undergoing **Cardiac Rehabilitation**?

- 76 Post MI cardiac rehab patients in Rochester, NY
- UFP and PM2.5 signif assoc with:
  - Subclinical
  - Decreased HR variability and prolongation of late repolarization duration
  - ^ Diastolic and Systolic BP
  - ^ CRP and Fibrinogen

Rich DQ. EHP Aug 2012

- Air pollution and health
- **Who is at risk?**
- What is the AQHI?
  - Scientific basis
  - Health messages
- Clinical practice guidelines and clinical application

Who's at risk – vulnerability/ exposure

- People with existing heart and lung disease
- Diabetics
- The elderly
- Young children
- Some members of the general population
- Pregnancy
- People who are active outdoors (exercise; workers)

- Air pollution and health
- Who is at risk?
- **What is the AQHI?**
  - **Scientific basis**
  - **Health messages**
- Clinical practice guidelines and clinical application

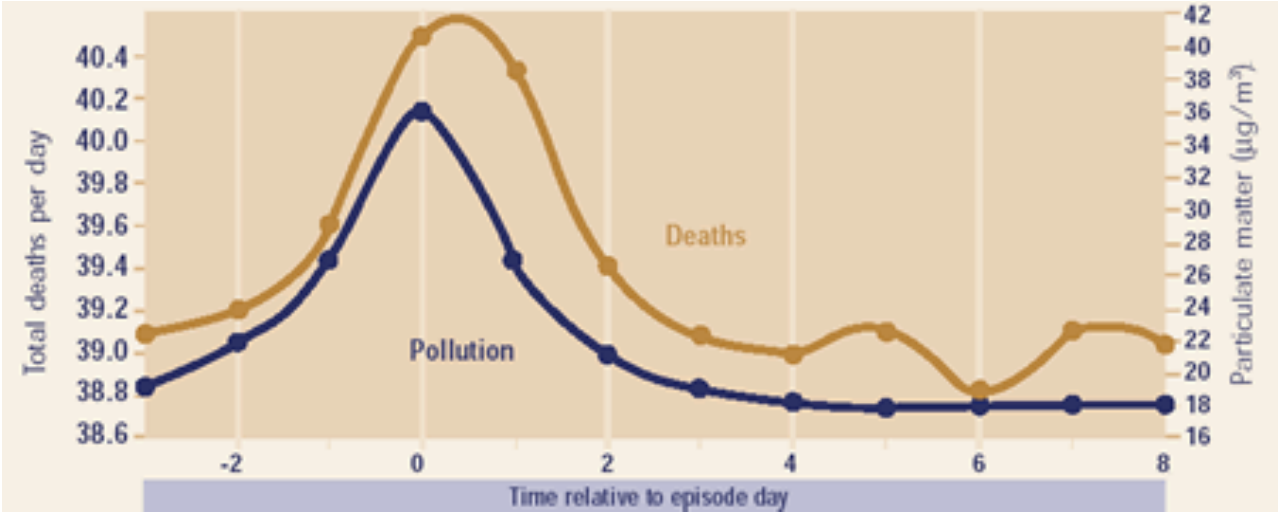
AQHI: Objectives

- To empower individuals to take action to protect their health from air pollution
- To create advocates for reducing pollution
- To support active living

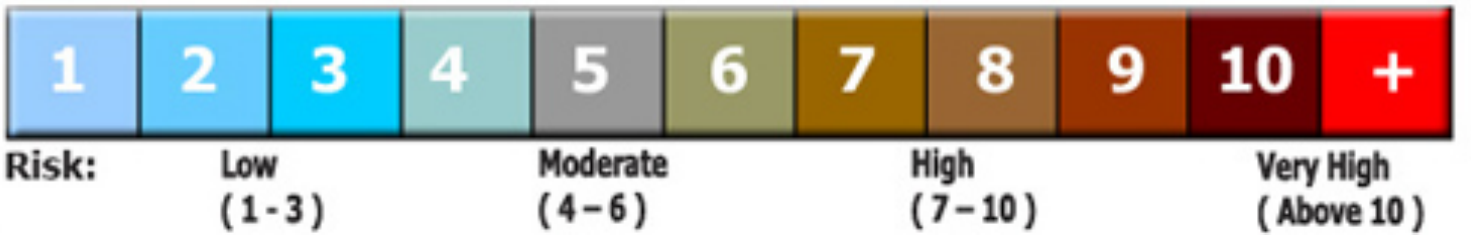
The evidence base for the AQHI

Calculating concentration-response coefficients

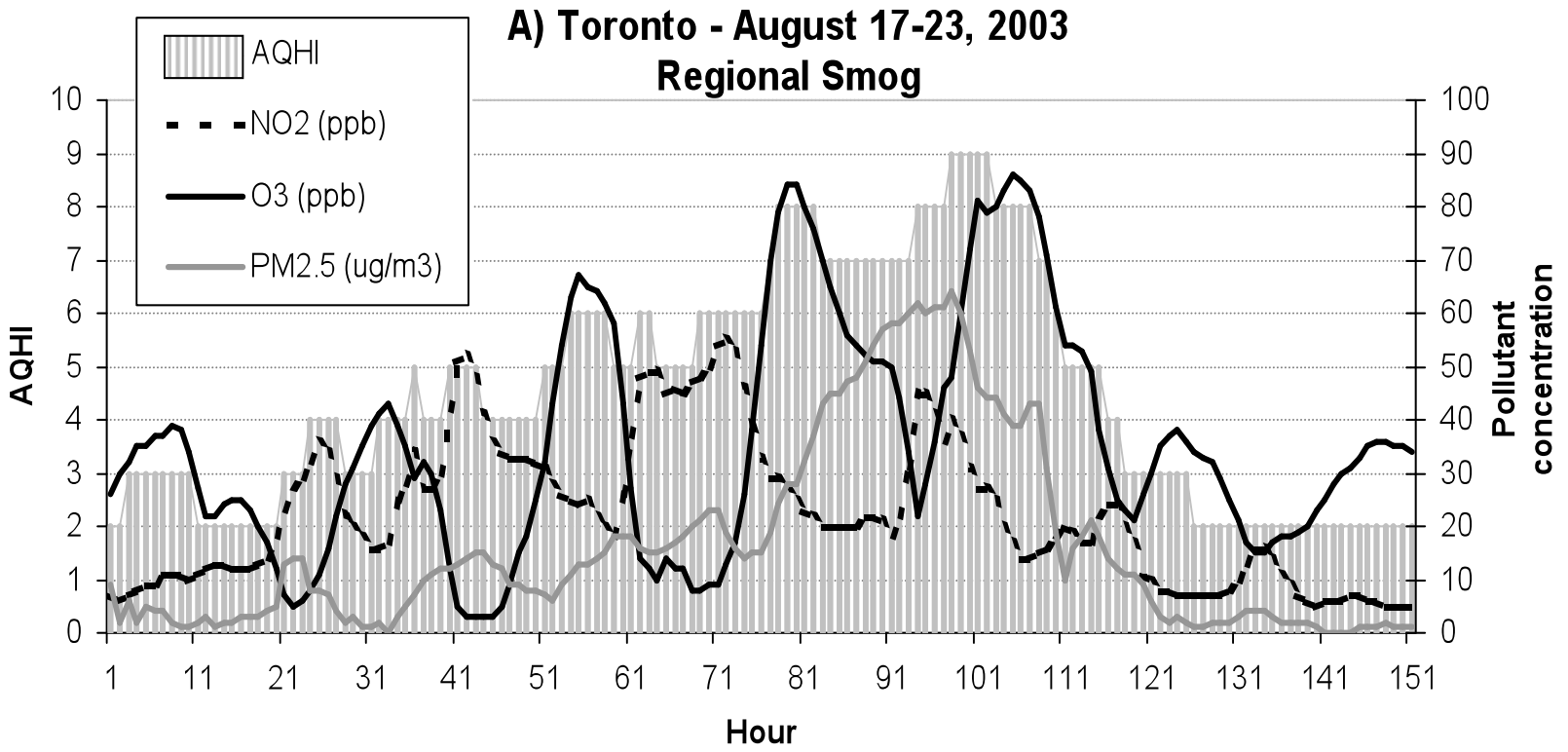
- Time series analysis, 1981-2000
- Air pollution data
- Mortality



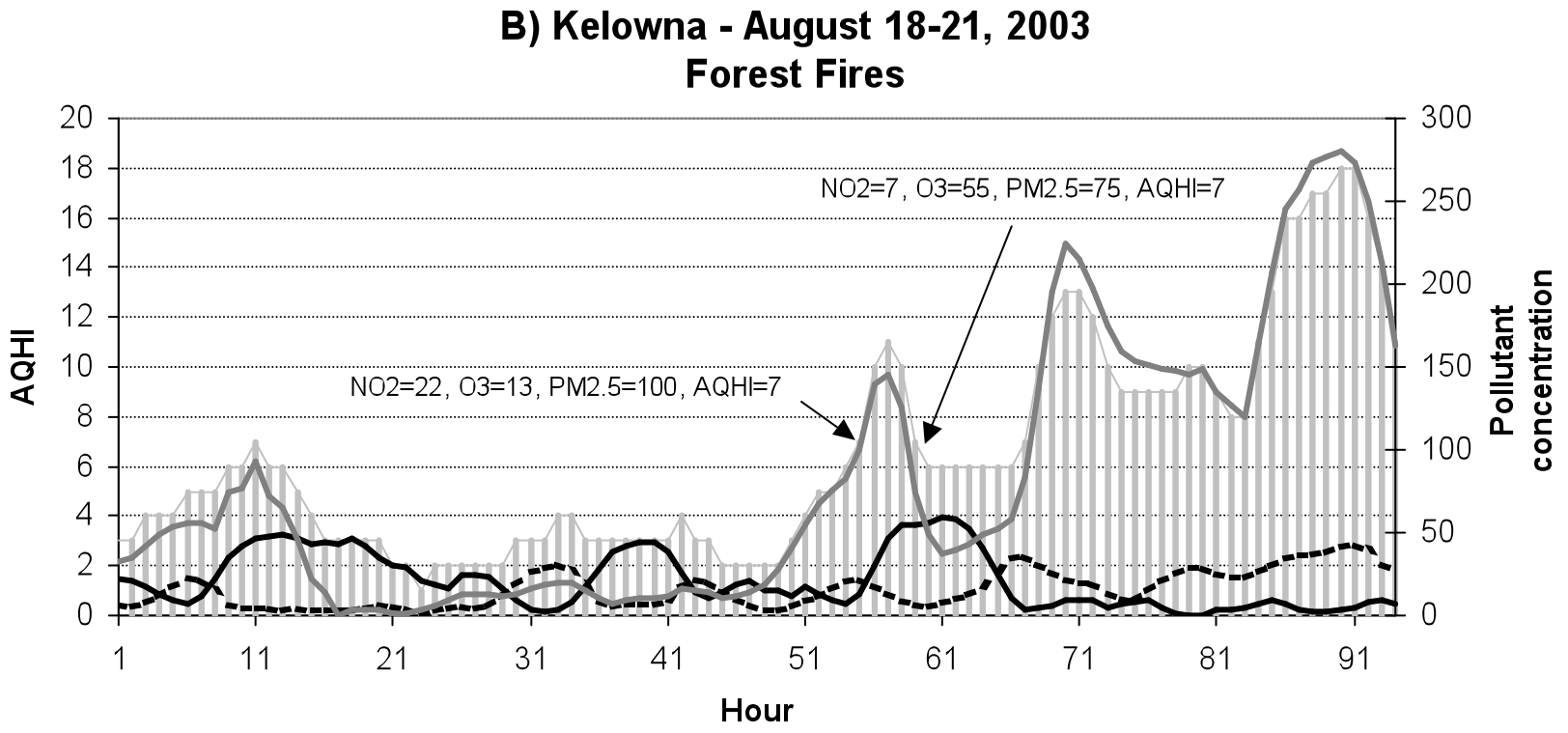
- Health effects at **low pollutant concentrations**
- **Mix** of multiple pollutants
  - NO_2
  - ozone
  - $PM_{2.5}$



Multi-Pollutant Performance



Single Pollutant Performance



Current

Current AQHI for Montréal

Forecast Maximums

Health Message

Issued at: 5:00 AM EDT Wednesday 9 October 2013

Wednesday	**3** - Low Risk	
Wednesday night	**3** - Low Risk	
Thursday	**3** - Low Risk	

Who is at risk?

People with heart and lung conditions are most affected by air pollution.

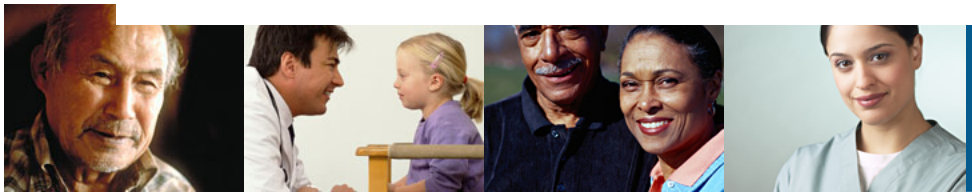
To find out if you are at risk, consult the health guide, or your physician.

Visit the national AQHI Web site to learn more about the AQHI.

Did you know...?

You can plant trees to fight air pollution: their leaves trap airborne particles, which are then washed away by the rain.

Wed October 9, 2013



Health Risk	Air Quality Health Index	Health Messages	
		At Risk Population*	General Population
Low Risk	1 - 3	**Enjoy** your usual outdoor activities.	**Ideal** air quality for outdoor activities.
Moderate Risk	4 - 6	**Consider** reducing or rescheduling strenuous activities outdoors if you are experiencing symptoms.	**No need to modify** your usual outdoor activities unless you experience symptoms such as coughing and throat irritation.
High Risk	7 - 10	**Reduce or reschedule** strenuous activities outdoors. Children and the elderly should also take it easy.	**Consider** reducing or rescheduling strenuous activities outdoors if you experience symptoms such as coughing and throat irritation.
Very High Risk	Above 10	**Avoid** strenuous activities outdoors. Children and the elderly should also avoid outdoor physical exertion.	**Reduce or reschedule** strenuous activities outdoors, especially if you experience symptoms such as coughing and throat irritation.

Short-term Exposures

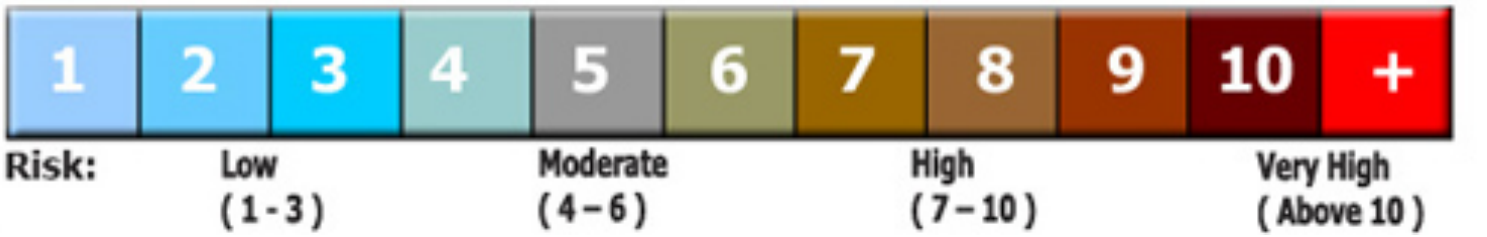
	Inhalation Rate
Adults	
Rest	0.4 m^3/hr
Sedentary Activities	0.5 m^3/hr
Light Activities	1.0 m^3/hr
Moderate Activities	1.6 m^3/hr
Heavy Activities	3.2 m^3/hr

8 fold

USEPA Exposure Factors Handbook, 1997

Finding out what AQHI value affects you

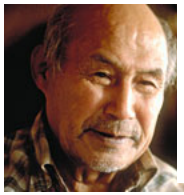
- Determine susceptibility (are you at-risk?)
- Self Calibrate



A national implementation

2012

In Canada, 74 communities receive the AQHI as of July 2012 (RI 10)



The AQHI risk in Montreal West (& North)

	AQHI Risk Category					
	Low	Moderate	High	Very High	Average Daily Max	# of Observations
2001	50.00%	46.43%	3.57%	0.00%	3.70	364
2002	60.52%	36.02%	3.46%	0.00%	3.48	347
2003	56.16%	39.18%	4.66%	0.00%	3.62	365
2004	63.81%	35.36%	0.83%	0.00%	3.29	362
2005	65.01%	32.78%	2.20%	0.00%	3.30	363
2006	76.44%	23.29%	0.27%	0.00%	2.85	365
2007	73.63%	25.55%	0.82%	0.00%	2.97	364
2008	66.67%	32.35%	0.98%	0.00%	3.13	306
Total	64.00%	33.89%	2.12%	0.00%	3.30	2836

	Low	Moderate	High
Montreal West	64%	34%	2%
Montreal North	39%	55 %	4.75%

Environment Canada 2010

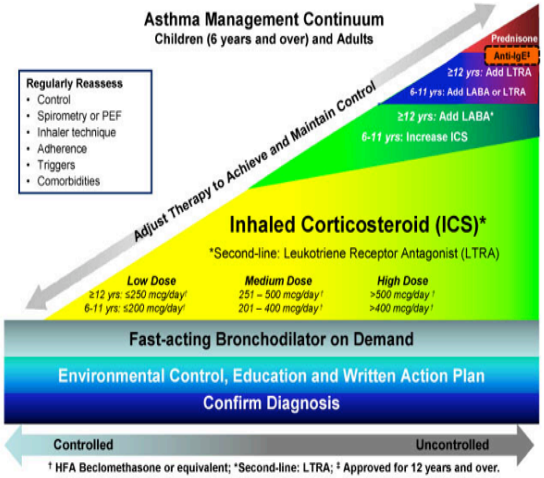
The AQHI risk in Calgary

	AQHI Risk Category					
	Low	Moderate	High	Very High	Average Daily Max	# of Observations
2001	21.10%	75.34%	3.56%	0.00%	4.33	365
2002	28.02%	67.58%	4.40%	0.00%	4.09	364
2003	21.10%	74.25%	4.11%	0.55%	4.35	365
2004	39.34%	59.02%	1.64%	0.00%	3.81	366
2005	48.22%	50.96%	0.55%	0.27%	3.68	365
2006	38.36%	60.55%	1.10%	0.00%	3.81	365
2007	49.32%	50.68%	0.00%	0.00%	3.65	365
2008	38.52%	60.38%	1.09%	0.00%	3.83	366
2009	32.05%	65.48%	2.47%	0.00%	4.02	365
Total	35.12%	62.69%	2.10%	0.09%	3.95	3286

Low	Moderate	High
35.12%	62.69%	2.10%

Environment Canada 2010

- Air pollution and health
- Who is at risk?
- What is the AQHI?
  - Scientific basis
  - Health messages
- **Clinical practice guidelines and clinical application**



Environmental control

Exposure to air pollution has been associated with increased morbidity and mortality in individuals with asthma.

Efforts to reduce exposure of patients with asthma to air pollution should continue

During periods of increased outdoor pollution,
patients can minimize exposure by remaining indoors
or reducing exercise outdoors

Lougheed MD, Lemiere C, Dell S et al. Canadian Thoracic Society Asthma Management Continuum – 2009. Can Respir J 2010

Circulation
JOURNAL OF THE AMERICAN HEART ASSOCIATION

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AHA Scientific Statement
Particulate Matter Air Pollution and Cardiovascular Disease

- All patients with CVD should be educated about the cardiovascular risks posed by air pollution
- On the basis of the forecast Air Quality Index, prudent recommendations for reducing exposure and limiting activity should be provided based on the patient's level of risk

Brook, RD. Circulation 2010

Patient knowledge

- Awareness of CVD - Air pollution link in at-risk cardiovascular patients:
  - Mostly unaware
  - Health care practitioner discuss link (7%)

– H&S Foundation 13%

Nowka M, Progress in Cardiovascular Diseases 2011

Could we be effective?

Change in outdoor activity due to media alerts on air quality in asthmatics

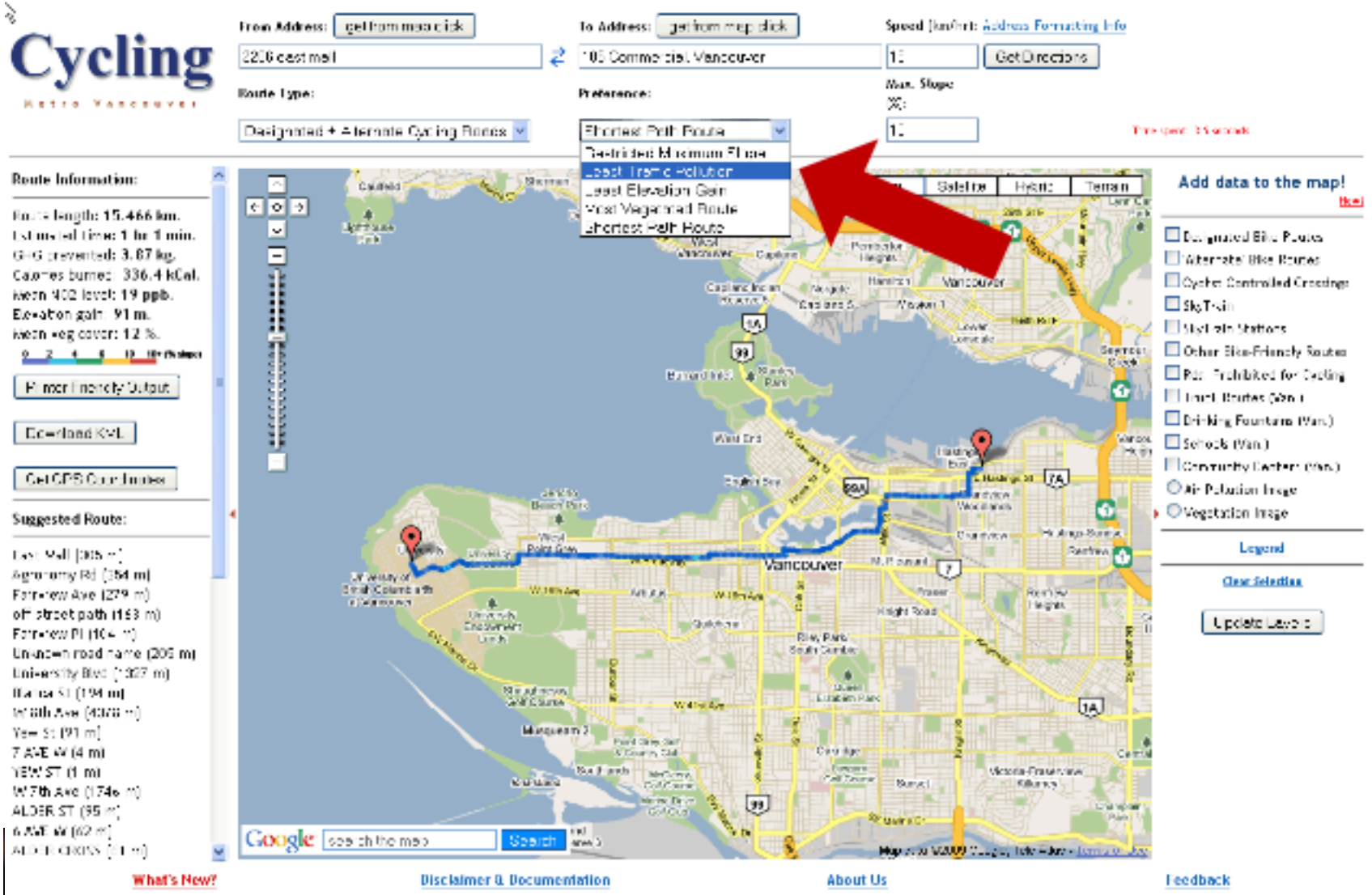
Prof advice received	57%
Prof advice not received	23%

Wen XL, J Comm Health 2008

Other interventions to reduce exposure

- Disease control (asthma controllers; heart failure)
- Traffic
  - Driving and exercising
- Indoor air
  - Intake fraction and indoor sources
  - Cleaning the air
    - HEPA filters
    - Air Conditioning

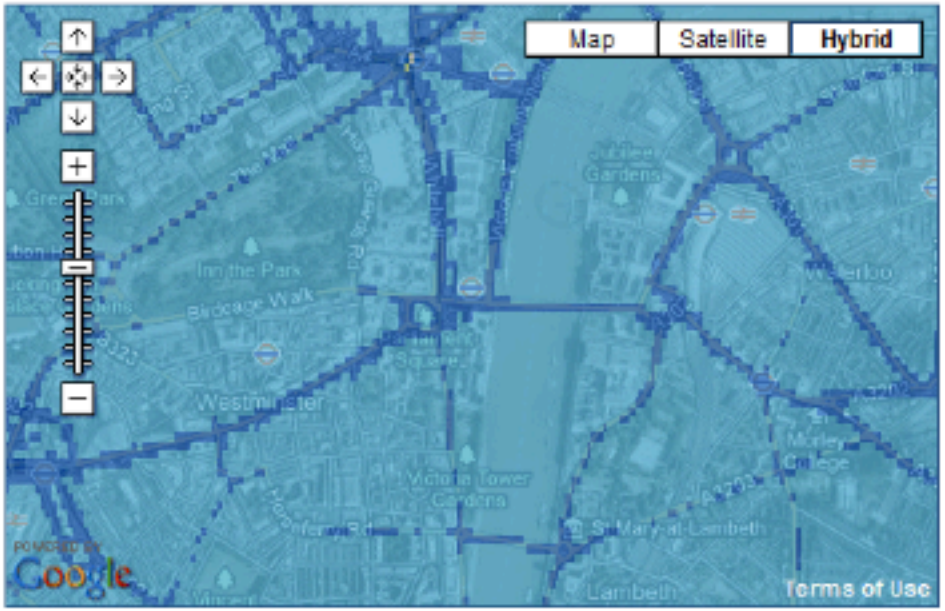
Cycling route planner



Su J, Brauer M, Winters M, Nunes M. Designing a route planner to facilitate and promote cycling in Metro Vancouver, Canada. In press, Transportation Research Part A: Policy and Practice, 2010, 44: 495–505.2010. **www.cyclevancouver.ubc.ca**

Nowcast - Current Pollution Maps

Enter postcode or area: Find



Estimated current NO2 air pollution index levels, based on measurements taken up to *05:00 on Tuesday 10th January*.

Select species: Nitrogen Dioxide (NO2) and visibility: 75% Update

What is a Nowcast?

The daily air quaity index changed on the 1st of January 2012. The current service for NO2 has been updated to the new index, but we are still testing our PM10 particles nowcast. We will produce an updated version of this in the near future.

This map shows a pollution *"nowcast"*, which is a pilot service to show current pollution levels in detail across London in comparison with the Government's Air Pollution Index. It is created by combining readings taken within the last hour and air pollution modelling in London. As you zoom into the map you will see which areas are currently experiencing higher pollution levels than others, usually those areas close to busy roads. More information about the Air Pollution Index and health advice associated with each index level can be seen here.

More Information

Why nowcast?

Measurements from monitoring stations are only able to report air quality at that particular place. The nowcast combines these measurements with our detailed model to show a prediction of what air quality is like across the whole of Greater London.

Why do you show only two pollutants?

The two pollutants chosen are ones which are known to have an effect on health within London and are able to be predicted with this model. Levels of carbon monoxide (CO) are now below those considered to be harmful to health, and emissions of sulphur dioxide (SO_2) are too unpredictable to create a map using this method. We hope to include ozone (O_3) in future nowcasts, but are still evaluating the accuracy of our ozone model.

Exercise

Create/ discuss the text for a 5 bullet patient education handout to Cardiac Rehab patients about air pollution, exercise and cardiovascular disease

You can help to protect your vulnerable patients from air pollution

1. Determine at risk patients
2. Tune in to the AQHI
3. Self calibration
4. Reduce or Reschedule strenuous activities
5. Traffic
6. Heat

Train the Trainer Program

Participants	Events	# Reached
27 Multidisciplinary	107	6028

Looking for cardiology representation

- Lectures/ talks/ rounds/seminars/ conferences/ workshops/webinars
- Opinion leaders

Learning Resources

UBC on-line course

- Accredited

Health effects of outdoor air pollution: an approach to counseling patients using the AQHI.

- Abelsohn A, Stieb DM.
- Can Family Physician; August 2011

Where you can find the AQHI

TV:

- The Weather Network

Internet:

- www.airhealth.ca
- www.theweathernetwork.com
- Provincial websites

Technologies

- Widget, Phone apps, E-alerts

Patient handouts

- michele.charrier@hc-sc.gc.ca
- Clean Air Champions

Green Heart Initiative

Greenheart

A healthier environment for healthier hearts

- Basic Info
- Health
- Research

Heart Facts

- Heart disease and stroke are the first and fourth leading causes of death in the U.S.
- Air pollution can affect heart health and can trigger heart attacks and strokes that cause disability and death.
- One in three Americans has heart or blood vessel disease and is at higher risk from air pollution.

EPA is raising awareness of heart disease and its link to air pollution and other environmental factors.

Featured Articles

- Nurses can help educate heart patients about poor air quality

http://www.airnow.gov

Resources

- www.airhealth.ca

- alan.abelsohn@utoronto.ca