What role does AQ - health research play in AQ Management?

- Identifying where new standards are needed and in setting the level and metric
  - adding support/further rationale for current standards
- Helping decide the best way to reduce levels so that benefits to public health are maximized
  - cost the least and have the widest political appeal
  - multiple benefits with greatest likelihood of no human and/or environmental health disbenefits

- **bang for the buck**
- **punch for the peso**
- **loads for the loonie**
Key research questions that could benefit from enhanced collaboration

- What are the effects of chronic (long-term) exposure to air pollutants?
  - Does air pollution contribute to the development or worsening of the main CV risk factors (hypertension, diabetes)?

- Are certain constituents, features or sources of PM more harmful and to who?

- How do we accurately quantify the health effects of what the population is really exposed to - a complex mixture?

- What are the true short and long term economic benefits of cleaner air?
  - Accountability
  - Does fighting $ with $ advance AQ policy or management?

- How can individuals reduce their exposure and what should they be most concerned about?
Specific AQ Science Studies

• Develop hybrid chronic exposure model capable of resolving inter and intra-urban variations with uncertainties (utilize info. from emissions, remote-sensing, models, measurements)
  – retrospective, lifetime exposure, multi-pollutant
• Carry-out detailed studies of particle/aerosol surface composition, reactivity, oxidative potential, volatility, morphology and temporal-spatial changes in real-world environment
• Identify and characterize multiple unique pollution climates, preferably among communities with similar populations
  – develop PM source apportionment for each
• Identify and characterize interventions (past, future) with marked AQ improvements
• Traffic exposure - motor vehicle emissions, mapped with high resolution
  – ultrafine particles are one of the most important issues
  – they are ubiquitous in one of our favorite microenvironments
  – their effects and exposure patterns are poorly understood (PM organics also)
• Study PM_{coarse}, especially in areas with high concentrations
Specific Actions by NARSTO

• Encourage AQ scientists to link with funded health studies and interact often to begin to understand each other’s culture
  – new round of PM Centers
  – recognize & reward interdisciplinary scientists

• Lobby funding bodies to initiate a suite of AQ studies targeted towards obtaining results that feed directly into health studies or fill gaps identified by health researchers

• Develop a joint, pro-active communications strategy to convey current knowledge and expert opinion to the public and decision-makers
Framework for exchange

• Identify some feasible or likely AQ management scenarios
  – e.g., NO$_x$ reductions for lowering [O$_3$], all regulations on the books and to be phased in over next ~5 years

• Quantify changes in inhalation exposure to all outdoor air pollutants for a given scenario
  – this will force AQ researchers to take stock of how far current tools can be pushed and to consider other options

• Challenge the health effects community to determine the total benefit of these changes
  – this will force them to think in a multi-pollutant sense and guide them towards assessments that relate to policy (i.e., may help focus the health effects research)
Integrating Science to Support Policy

Model Air Concentration Changes

Model Exposure Changes

Model Value of Health Benefits

Accept/Reject Reduction Strategy

Model Emission Changes

Pollution Reduction Strategy
Understanding each other’s culture

• Critical for discovering new ways to look at our problems
• AQ researchers recognize that it’s one atmosphere, but health researchers have to deal with the fact that humans are influenced by one environment

• The air pollutant mix is ultimately most important, but fine particles do deserve attention
  – They are ideal for delivering foreign substances to the deep lungs and circulation (into the body)

• PM effects must be a function of surface composition, which in turn is influenced by a variety of factors
  – source, atmospheric processing, surrounding gases (and vice versa-?)

• PM effects must be a function of the recipient's susceptibility, which in turn is influenced by a variety of factors
  – Age, drugs, acute and chronic disease(s), genes, chronic air pollutant exposure, other (?)
Is research what is needed?

• If we accept that air pollution is a significant problem, that the science is sufficient .....  
  – then perhaps more science is not what is needed or at least not all that is needed  
  – to influence AQ management decisions (or lack of) enhanced communication is needed  
  – what we (the 2 communities) believe the science is telling us needs to break the economic barrier  
  – Economic and political instruments need to be improved
Misc. Ideas/Thoughts

• Link with a cohort and upgrade exposure measurements and modeling
  – New birth cohorts are forming and would be ideal to rally around
  – Help pick the cohort to maximize the exposure gradient

• The fields of urban and transportation planning need to become an equal partner along with AQ and health effects research

• Research implies a relatively long time frame and is costly

• Standards/targets already exist and thus for more-effective AQ management we are not trying, via joint research, to set new ones

• We are trying to rank the possible actions that could be taken wherever there is a problem (documented or perceived)

• What are the criteria for ranking?
More Misc. Ideas/Thoughts

• NARSTO should take responsibility for broadening our perspective
  – Human health is not all that matters (e.g., acidic deposition, vsby)
  – PM or common air pollutants are not all that matter (e.g., toxics)
  – Climate change will alter the situation
• Trace metal speciation still not done sufficiently
• Will adding more and more to the “bad news” lead to actions being taken?
Goals

• concrete suggestions as to how we can move the science forward,
• concrete suggestions as to how we can improve protection of public health
• concrete suggestions as to how we can achieve better air-quality management
Health Effects Consensus Findings
(Independent Expert Panel)
Reducing sulphur in gasoline to 30 ppm

Benefits from lower particulate sulphate in Canada

Number of Cases Extrapolated for All of Canada 2001 to 2020

- Mortality: 2,100
- Hospital Admissions: 2,400
- Emergency Room Visits:
  - new cases of chronic bronchitis: 6,800
  - new cases of bronchitis in children: 7,600
  - restricted activity days: 93,000
  - asthma symptom days: 1.6 million
  - acute respiratory symptoms:
    - e.g.: new cases of croup, pneumonia: 3.3 million
  - total: 11 million

~ ½ of billion $ per year from avoided mortality alone
Estimated Exposure to Traffic-Related Air Pollution (nitrogen dioxide) in Toronto

KANAROGLOU et al. (2004)
ULTRAFINE Particle Counts as high as 1.4 million per cc on a major highway in heavy traffic
Organics on PM$_{2.5}$ explain some of the variability in vasoconstriction and blood pressure increases.

\[ y = -0.0085x + 0.1082 \]

\[ r = 0.45, p = 0.036 \]
Grid Size vs. Population Distribution

Hypothetical 40 km x 40 km grid
Need to Include Climate Change

Projected equivalent CO₂

Global ave. T from CGCM2

Regional climate and weather patterns

Model Emission Changes

Model Air Concentration Changes

Pollution Reduction Strategy

Model Exposure Changes

Model Value of Health Benefits

Model Changes in health effects

Accept/Reject Reduction Strategy