

TORONTO STAFF REPORT

October 15, 2001

To: Board of Health
From: Dr. Sheela V. Basrur, Medical Officer of Health
Subject: Condition Critical: Fixing Our Smog Warning System - Summary Report

Purpose:

This report provides a brief summary of the report entitled Condition Critical: Fixing Our Smog Warning System and seeks Board approval of the recommendations based on that report.

Financial Implications and Impact Statement:

There are no direct financial implications associated with this report for Toronto Public Health or the City of Toronto.

Recommendations:

It is recommended that the Board of Health:

1. Request that the Ontario Minister of the Environment improve the Air Quality Index (AQI) and smog advisory notification system as set out in the report *Condition Critical: Fixing our Smog Warning System* by:
 - (a) Restructuring the AQI system to make it a more accurate indicator of health concerns by:
 - (i) Adding fine particulates (PM₁₀ and/or PM_{2.5}) to the mix of pollutants used to calculate the AQI;
 - (ii) Updating the Ambient Air Quality Criteria (AAQC) for nitrogen dioxide, carbon monoxide and sulphur dioxide to reflect current research on the human health effects associated with these air pollutants; and

- (iii) Developing a new formula to calculate AQI values that takes into account the total pollutant contributions for each given hour;
- (b) Restructuring the AQI messaging system by:
- (i) Emphasizing that the AQI is a continuous scale in which health risk increases as the AQI number increases;
 - (ii) Re-naming “Air Quality Advisories” as “Smog Alerts” to increase public understanding that serious air pollution episodes are occurring;
 - (iii) Discontinuing the practice of describing air quality as “good” or “very good” when the AQI is less than 32;
 - (iv) Replacing the current AQI classifications (very good, good, moderate, poor and very poor) with more appropriate classifications (background, low, medium, high and smog alert) by May 2002;
 - (v) Continuing to forecast and trigger “air quality advisories” or “smog alerts” when some predetermined AQI value (such as a regulatory standard) is exceeded; and
 - (vi) Developing a special messaging system that alerts sensitive populations (such as the elderly, children and those with respiratory and cardiac problems) to AQI values that pose increased health risks; and
- (c) Accelerating the implementation of province-wide continuous monitoring of fine particulates (PM₁₀ and/or PM_{2.5});
2. Request that the Government of Ontario ensure that sufficient resources are made available to the Ministry of the Environment to implement continuous monitoring of fine particulates across the province, and to improve the Air Quality Index (AQI) as outlined in recommendation 1;
 3. Request that the federal and provincial Ministers of Health provide the federal and provincial Ministers of the Environment with updated information on the adverse health effects anticipated at different Air Quality Index (AQI) values based on current national and international health studies;
 4. Request that the federal Minister of the Environment ensure that the proposed new national Air Quality Index (AQI) for Canada includes fine particulates and encompasses a health effects warning system that accurately conveys the health risk associated with AQI values for both the general population and more sensitive sub-populations;
 5. Convey to the federal and provincial Ministers of the Environment that the Toronto Medical Officer of Health has offered to assist in the review of improved health messaging associated with the Air Quality Index (AQI);

6. Forward this report to the GTA Clean Air Council, all health units in Ontario, the Ontario Public Health Association, the Canadian Public Health Association; the Canadian, Ontario and New Brunswick Lung Associations; the Association of Municipalities of Ontario, and the Federation of Canadian Municipalities for their information and action as appropriate; and
7. Request that the appropriate city officials be authorized and directed to take the necessary action to give effect thereto.

Background:

In May 2000, staff submitted to the Board a report entitled *Air Pollution Burden of Illness – Summary Report* which indicated that air pollution leads to approximately 1,000 premature deaths and 5,500 hospitalizations in Toronto each year. In that document, it was reported that while all smog alerts in Toronto are triggered by ozone, ozone is responsible for less than 5% of the premature deaths and about 30% of the hospitalizations attributed to air pollution in Toronto. These facts suggest that Ontario's Air Quality Index (AQI), which is used to trigger smog alerts, is not identifying the many situations in which human health is being affected by air quality in Toronto.

The accuracy of the Air Quality Index (AQI) is very important to the Medical Officer of Health because she depends upon the AQI to: (1) trigger smog alerts and the corporate Smog Alert Response Plan for the City; (2) to encourage emission reduction activities among individuals (such as through the emerging 20/20 – *The Way to Clean Air* campaign) and institutions within the broader community; and (3) to inform vulnerable populations about the precautions to be taken by them to protect their health when air pollution levels are elevated.

In order to clarify the extent to which Ontario's Air Quality Index (AQI) reflects the human health effects associated with air quality, Toronto Public Health conducted a second study entitled, *Toronto Air Quality Index – Health Links Analysis* (referred to as the Health Links study). Building on the methodology applied in the first *Air Pollution Burden of Illness*, this new study has been designed to calculate the number of premature deaths and hospitalizations that occur when air quality in Toronto is rated as "very good", "good", "moderate" and "poor" by Ontario's Air Quality Index (AQI). The results of this second study have been incorporated into the broader policy report entitled, *Condition Critical: Fixing Our Smog Warning System* (referred to as the Condition Critical report), that has been summarized in this Board report.

The Health Links study has been conducted by Dr. David Pengelly and staff from the Health Promotion and Environmental Protection Office in Toronto Public Health. Both the Health Links study and the Condition Critical reports have benefited from discussions with a Project Advisory Committee that included representatives from the Ontario Ministry of the Environment (OMOE), Environment Canada, the Ontario Ministry of Health and Long-term Care, the Office of the Chief Administrative Officer for the City of Toronto, Toronto Works and Emergency Services, the Ontario Association of Family Physicians, the Ontario Medical Association, the

Pollution Probe Foundation, and the Toronto Environmental Alliance. This research project was funded by the Salamander Foundation.

Comments:

(a) Ontario's Air Quality Index

The AQI has the potential to be an extremely valuable communications tool that can inform the public about the need for shifts in behaviour year round. It is essential, however, that the messages being conveyed by the AQI reflect the most current human health effects literature. At present, the public cannot reconcile the fact that the AQI indicates that air quality in Toronto is "good" or "very good" most of the time, when Toronto Public Health is indicating that air quality is leading to approximately 1,000 premature deaths each year. These "mixed messages" could undermine the effectiveness of the City's emerging clean air campaign (*20/20 – The Way to Clean Air*) that is designed to encourage a 20% reduction in the use of vehicles and energy within the City.

Ontario's AQI is comprised of measurements of sulphur dioxide (SO₂), carbon monoxide (CO), nitrogen dioxide (NO₂), ozone (O₃), total reduced sulphur (TRS) and coefficient of haze (COH) or total suspended particulates (TSP). Fine particulates (PM₁₀ or PM_{2.5}) are not part of the Ontario AQI. The AQI is divided into five categories that correspond to a concentration range for each pollutant. After each hour of sampling, the concentration of each pollutant at each monitoring station is converted into a number that corresponds to the AQI scale. AQI values are classified as follows:

AQI Scale	Category
0-15	Very good
16-31	Good
32-49	Moderate
50-99	Poor
100+	Very poor

(b) Toronto Air Quality Index – Health Links Analysis

Table 1 summarizes the results of the Health Links study. It also includes the number of air-pollution related adverse health outcomes first calculated in the previous *Air Pollution Burden of Illness* study. This table also shows the relative distribution in a specific health outcome for each pollutant across the four air quality classifications – very good, good, moderate and poor.

Table 1. Summary of Distribution of Adverse Health Outcomes by AQI Category (Toronto 1995):

Health Outcome	Estimated Number of Cases	% of Health Outcomes			
		Very Good	Good	Moderate	Poor
Premature Deaths	1,317	64	32	3	<1
Respiratory Hospitalizations	2,085	61	35	3	<1
Cardiac Hospitalizations	4,426	47	35	14	4
All outcomes		58	34	7	1

(c) Significant Burden of Illness Occurs when Air Quality is “Good”

While not intentionally, the current AQI system conveys the impression to the public that air pollution is without health risk, and therefore not a concern until AQI values reach the “poor” classification (i.e., when AQI reaches 50). The results of the Health Links study indicate that about 92% of the premature deaths and hospitalizations attributable to air pollution in Toronto occur when air quality has been classified as “good” or “very good” by Ontario’s AQI. In other words, air quality that is currently classified by the AQI as “very good” or “good” is responsible for the major portion of the adverse health effects seen in the Toronto population attributable to air pollution. This is a very significant finding that indicates that the current AQI system does not accurately reflect health risk associated with existing pollution levels.

The statistical illusion that the least health burden occurs when the pollution levels are the highest arises from the fact that there are many more “good” air quality hours and days than there are “poor.” On any specific day when pollution levels are high, the overall number of adverse effects is greater than on any specific day when pollution levels are low. However, there are many more hours and days of “very good” or “good” air quality than there are “moderate” or “poor” air quality. It is the many hours/days of somewhat lower levels of air pollutants that contribute to the large burden of ill health and premature mortality that has been observed in Toronto.

It is not that the current AQI is wrong. On those days when smog alerts are called, air pollution is a serious health issue, however, Toronto Public Health’s research suggests that it is a serious problem on other days as well.

(d) Most Health Effects Occur Below Regulatory Limits

The study demonstrates that most of the adverse health effects associated with each of the six air pollutants occur when air levels are well within their respective air standards. For ozone and carbon monoxide, about 80% of the health effects occur at air levels rated as “very good” or “good” by the AQI. For nitrogen dioxide and sulphur dioxide, about 95% of adverse health

effects occur at levels rated as “very good” or “good” by the AQI. In the case of particulates, 100% of adverse health effects in Toronto residents occur when the air quality is described provincially as “good” or “very good”. When air pollutants are rated as “very good” or “good” by the AQI, they are present at air levels well within their respective air quality standards (see Condition Critical report for details).

Were the air quality criteria for carbon monoxide, nitrogen dioxide, and sulphur dioxide revised to better reflect current health effects research, it is reasonable to predict that some more days would be designated as “poor” air quality days in the city. And because these three air pollutants tend to be present at greater levels in the winter months, it is likely that this could result in “smog alerts” being issued in the winter months as well as in the summer months. Cold weather “smog alerts” could have a beneficial impact on public education and policy development related to air quality. They could reinforce the need to develop long-term, year round emission reduction behaviours, practices and programs at both the individual and institutional level.

(e) Significant Burden of Illness Associated with Fine Particulates

While the OMOE introduced an interim 24-hour criterion for fine particulates (PM₁₀) of 50 ug/m³ in 1997 that better reflects health concerns than total suspended particulates (TSP), fine particulates have not yet been added to Ontario’s AQI. The results of this study reinforce the importance of incorporating fine particulates (PM₁₀ or PM_{2.5}) into Ontario’s AQI. Fine particulates (PM₁₀) are responsible for about 27% of premature deaths, 44% of respiratory hospitalizations, and 35% of cardiac hospitalizations attributable to air pollution in the City of Toronto each year (see Condition Critical report for details). This is too significant a burden of illness to be excluded from an air quality rating system. In order for the AQI to function as an effective public warning system, it must include fine particulates so that people can be notified when fine particulates are present at air levels that could be harmful to health. This is particularly important for those people with pre-existing conditions such as heart problems who are at greatest risk.

(f) Misleading Messages Associated with AQI

There is a dichotomy between the messages conveyed by Ontario’s AQI and those conveyed air quality and health experts. On the one hand, the AQI indicates that air quality in Toronto is “good” or “very good” 95% of the time, while on the other hand, Toronto Public Health’s research shows that air pollution leads to approximately 1,000 premature deaths and 5,500 hospitalizations in the city each year. Furthermore, while Toronto Public Health’s research indicates that air pollution is affecting health year round, the AQI triggers smog alerts only on a few days in the summer months. These mixed messages can confuse the public and undermine its willingness to reduce household emissions year round, such as through energy conservation and reduced vehicle use where possible. In order to realize its potential as a valuable public education tool, the AQI must be revised to more accurately reflect the health risks presented by various levels of air pollutants.

A growing body of scientific evidence is challenging the notion that a threshold or ‘safe’ level exists below which smog-related pollutants do not harm human health. It is therefore important

to reconsider the structure of the AQI messaging system to get away from discrete categories (i.e., “good” and “poor”) and emphasize that the AQI is a continuous scale, similar to that used for the UV Index. By emphasizing the continuous nature of the AQI scale, one is better able to convey to the public that the higher the AQI number, the greater the health risk.

(g) The Need for an Improved AQI

Given that it may take many years before air quality is improved substantially, there is a need to ensure that the public has accurate information about the health effects associated with various levels of air pollution so that individuals can take steps to protect themselves and their families. This is especially important for sensitive populations such as seniors, young children and those with cardiac and respiratory illnesses who are particularly vulnerable to air pollution. While improvements in smog-related air quality have stalled in Toronto for the last 15 years, the populations that are sensitive to air pollution are large and in some cases growing. For example, there were about 48,000 hospitalizations of Toronto residents for “breathing or heart problems” in 1998. The increasing size of a vulnerable subpopulation is demonstrated by the doubling in the number of seniors in Toronto between 1971 and 1996 while the overall population increased by only 14%. Furthermore, Ontario’s Chief Medical Officer of Health has estimated that the prevalence of asthma in children under 14 has risen dramatically from 2.5% in 1983 to 11.2% in 1995.

(h) How To Improve the AQI Overall

There are several reasons why the current AQI communications system misrepresents the health risk associated with air pollution levels. It does not include fine particulates (e.g. PM₁₀ and/or PM_{2.5}) that are known to contribute significantly to the harmful effects of air pollution. The air quality standards for several pollutants (carbon monoxide, sulphur dioxide and nitrogen oxides) that make up the AQI are seriously out-of-date and do not reflect the current health effects literature. Furthermore, the AQI public reporting mechanism is based on a single “driver” pollutant and does not reflect the health effects that can occur when people are exposed to increased levels of several smog-related air pollutants simultaneously. By calculating the hourly AQI values in a way that takes into account the sum of pollutant contributions for a given hour, the AQI could better predict health risk and therefore function as a better warning system.

The AQI has the potential to be an extremely valuable communications tool that can educate the public about the need for shifts in behaviour year round and to inform sensitive populations about the times when precautions should be taken because of increased air pollution levels. To improve the AQI, the following five-point action plan should be implemented:

- (1) Add fine particulates (PM₁₀ and/or PM_{2.5}) to the AQI;
- (2) Replace the current AQI classifications (very good, good, moderate, poor and very poor) with more appropriate classifications (background, low, medium, high, smog alert);
- (3) Update the health effects information disseminated with the AQI to reflect the current knowledge on associated human health effects, and include special messages designed for vulnerable populations;

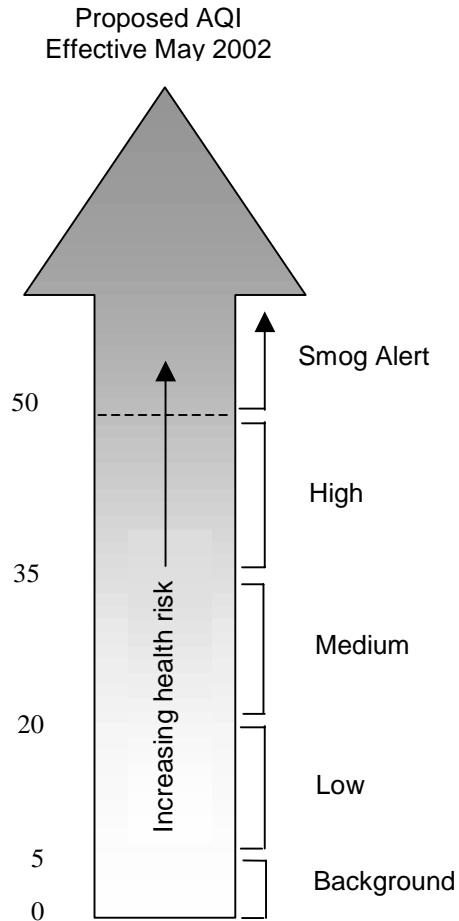
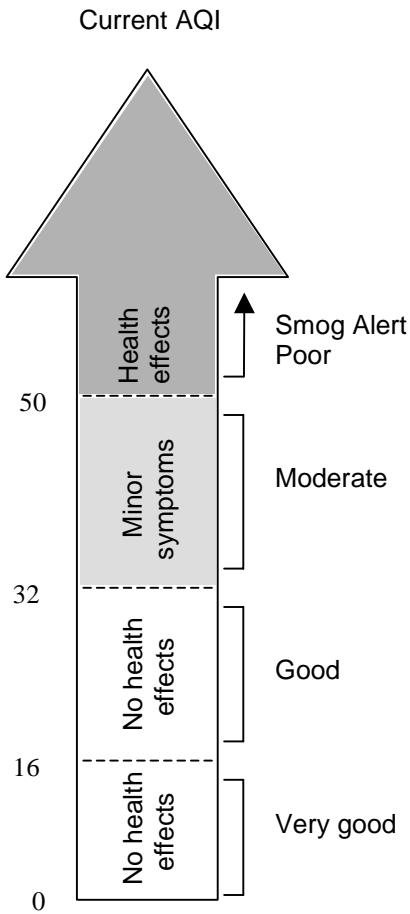
- (4) Update regulatory standards for air pollutants included in the AQI (especially nitrogen dioxide, carbon monoxide and sulphur dioxide); and
- (5) Revise the AQI formula to reflect cumulative health impacts associated with simultaneous exposure to multiple pollutants included in the AQI.

The first three points in the plan are urgently needed and relatively easy to do. They should be implemented before May 2002 when next summer's smog season begins. The fourth and fifth points will take longer to accomplish because of the intensive nature of the research and consultation involved in standard setting and assessing cumulative impacts, however, they are essential components in the ongoing improvement of the AQI.

(i) How to Improve the AQI Health Effects Messaging System

It would be a relatively easy matter to improve the health effects messaging around the AQI so that it no longer conveys the erroneous impression that there are few if any adverse health effects associated with AQI levels below those that trigger air quality advisories or smog alerts. The figure on the left (Current AQI) that follows depicts how the current AQI misrepresents health risk. The figure on the right (Proposed AQI Effective May 2002) shows how it is possible to keep the existing AQI scale, including the Smog Alert trigger when AQI reaches 50, and still convey that all air pollution levels above background entail preventable health risk. By introducing the classifications "background", "low", "medium", "high" and "smog alert", the public messages are still kept very clear and simple.

Additional health messages would need to be developed directed at vulnerable populations that encourages them to pay attention to the AQI values as they increase into the medium or high range so that they can take appropriate personal protection measures. Physicians, nurses and public health staff would likely be willing to help in the communication effort of alerting vulnerable populations in their respective communities about the AQI if they had confidence that it was accurately reflecting health risk.



The current AQI misrepresents health risk by conveying to the public that there is no health risk when the AQI is less than 32 and in the “good” or “very good” range. It is not until the AQI reaches 50 that health risks are publicized. This puts vulnerable populations at risk who experience adverse health impacts at AQI levels below 50. It also undermines public education efforts to encourage the public to reduce household emissions because they are led to believe that air quality is good or very good most of the time.

To ensure a smooth transition to an improved AQI in 2002, it is proposed that the current number scale for the AQI be maintained but that the descriptive labels are changed. It is also essential that fine particulates be added to the AQI formula so that smog alerts are triggered when PM_{10} exceeds its provincial standard. As a result, a slight increase in the number of Smog Alerts would be expected in 2002 compared with ‘typical’ years.

In the new system, Smog Alerts would still be triggered once AQI reaches 50. This would happen when any one AQI pollutant exceeds its regulatory standard. In addition, the new system would emphasize increasing health risk as the AQI number gets bigger. Special messages would be developed for vulnerable populations that alerts them to increased health risks as the AQI values increase to the “medium” and “high” range.

Conclusions:

Ontario's Air Quality Index (AQI) does not currently provide an accurate picture of the health risk associated with air quality. The *Toronto Air Quality Index – Health Links Analysis* study, upon which the *Condition Critical: Fixing our Smog Warning System* policy report is based, demonstrates that 92% of the premature deaths and hospitalizations attributable to air pollution in Toronto occur when air quality has been classified as “very good” or “good” by Ontario's Air Quality Index (AQI).

The *Condition Critical* report identifies a Five-Point Action Plan for the improvement of the provincial Air Quality Index (AQI) and smog warning system used in Ontario that may be applicable to other jurisdictions in Canada as well. That plan includes the following points: 1) implement province-wide continuous monitoring of fine particulates (PM₁₀ and/or PM_{2.5}) and add fine particulates to the AQI; 2) replace the descriptive AQI categories (e.g. “very good” and “poor”) with more appropriate descriptions (e.g., low, medium, high); 3) use the latest scientific research to describe health effects expected at all pollution levels and develop a special messaging system that alerts vulnerable subpopulations to the health risks that they may encounter at lower pollution levels; 4) update the regulatory standards for the air pollutants included in the AQI to ensure that they better reflect adverse health effects; and 5) revise the AQI formula to reflect the cumulative health impacts associated with simultaneous exposures to more than one air pollutant, and establish an AQI value that triggers “smog alerts” (eg. exceedance of regulatory standards).

An improved AQI and smog warning notification system would benefit Toronto residents in several ways. First of all, it would more accurately identify those times when smog alerts should be issued because of the increased health risks presented to the overall population. Secondly, it would more accurately identify those days when air quality presents a concern for sensitive populations such as young children, seniors and those with pre-existing medical conditions. Thirdly, it would convey a more accurate picture of air quality year round and encourage greater engagement by the general public in the behavioural shifts required to improve air quality in the long-term. An improved AQI system is deemed essential to the success of Toronto's emerging *20/20 – The Way to Clean Air* campaign (a social marketing campaign designed to encourage a 20% reduction in the use of vehicles and energy within Toronto) that is scheduled to be launched next year.

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List of Attachment:

Report: *Condition Critical: Fixing Our Smog Warning System*, October, 2001