

TORONTO STAFF REPORT

March 19, 2002

To: Board of Health

From: Dr. Sheela V. Basrur, Medical Officer of Health

Subject: Ten Key Carcinogens in Toronto Workplaces and Environment: Assessing the Potential for Exposure

Purpose:

The purpose of this report is to provide highlights of the appended report entitled, "Ten Key Carcinogens in Toronto Workplaces and Environment: Assessing the Potential for Exposure" that has been prepared in response to recommendations contained in both Toronto's Cancer Prevention Action Plan and Toronto's Environmental Plan, and to seek support from the Board of Health for the recommended course of action.

Financial Implications and Impact Statement:

No net additional resources will be required for the 2002 Toronto Public Health budget.

Recommendations:

It is recommended that the Board of Health:

- (1) request the Medical Officer of Health to:
 - (a) identify strategies that can be taken to reduce the release of the ten key carcinogens, giving priority to benzene, dioxins and PAHs;
 - (b) report back to the Board of Health on these strategies; and
 - (c) continue to liaise with the Ontario Ministries of Labour and Health and Long-term Care, and with Cancer Care Ontario, to ensure that Toronto workers are adequately protected from occupational exposures to carcinogens in Toronto workplaces;

- (2) request the Ontario Minister of the Environment and the Federal Ministers of Health and the Environment to:
 - (a) provide Toronto-specific data on the levels of asbestos and chromium (VI) in Toronto's outdoor air;
 - (b) expand their respective emission release inventories to include a greater percentage of small and medium-sized point sources; and
 - (c) move quickly to establish a health-protective air standard for polycyclic aromatic hydrocarbons (PAHs) as a whole;
- (3) request that Cancer Care Ontario and the Ontario Minister of Labour give priority to the investigation and assessment of occupational exposure to the following known and probable carcinogens in industrial sectors in Toronto:
 - (a) PAHs in the land transport sector;
 - (b) tetrachloroethylene in the clothing apparel manufacturing sector and personal and household services sector;
 - (c) formaldehyde in the furniture and fixtures manufacturing and clothing apparel manufacturing sectors;
 - (d) chromium (VI) in a number of manufacturing sectors;
 - (e) benzene in the personal and household services sector and wholesale, retail trade, restaurants and hotels sector; and
 - (f) asbestos in the wholesale, retail trade, restaurants and hotels sector;
- (4) encourage Cancer Care Ontario and the Ontario Ministers of Labour, of the Environment, and of Health and Long-term Care to prioritize all occupational and environmental carcinogens for further assessment and toxics reduction where appropriate;
- (5) send a copy of this report to the Ontario Ministers of Labour, the Environment, and Health and Long-Term Care, and to the Federal Ministers of Health and the Environment, and to Cancer Care Ontario, the Toronto Cancer Prevention Coalition, and the Commissioners of Works and Emergency Services and Corporate Services; and
- (6) request that the appropriate city officials be authorized and directed to take the necessary action to give effect thereto.

Background:

At its meeting of July 27, 1998, the Board of Health supported the formation of the Toronto Cancer Prevention Coalition and requested that it report back to the Board with a proposed action plan for cancer prevention. At its meeting of May 22, 2001, the Board of Health received a report entitled, "Toronto Cancer Prevention Coalition Action Plan" and endorsed, in principle, the 20-point action plan developed by the Toronto Cancer Prevention Coalition. Five of the recommendations in that plan are targeted at chemical and physical carcinogens in Toronto's workplaces and environment.

In May 2000, Toronto City Council approved, in principle, the plan prepared by Toronto's Environmental Task Force entitled, "Environmental Plan, Clean, Green and Healthy, A Plan for an Environmentally Sustainable Toronto" (February 2000). Several of the recommendations contained in this plan are directed towards toxic air pollutants. Recommendation 20a) indicates that the City should work to make Toronto's air clean and free of harmful levels of pollutants. Recommendation 22a) indicates that the City should assess the need to improve City, provincial and federal emissions inventories, while recommendation 22c) indicates that the City should explore the feasibility of introducing a by-law to restrict point source emissions.

This report has been prepared to provide background information to support the on-going work of the Toronto Cancer Prevention Coalition, and to support City staff with the implementation of the recommendations contained in both the Coalition's May 2001 report and the Environmental Task Force's May 2000 report. This report summarizes the policy report entitled, "Ten Key Carcinogens in Toronto Workplaces and Environment", which is based in large part on the technical report entitled, "Assessing the Potential for Occupational and Environmental Exposure to Ten Carcinogens in Toronto". The technical report was prepared for Toronto Public Health by Dr. Pavel Muller of ToxProbe Incorporated, and benefited from the direction and advice of a Project Advisory Committee that included staff from the Ontario Cancer Institute, the Ontario Ministries of Labour and the Environment, the Occupational Health Clinic for Ontario Workers, the Toronto Environmental Alliance (TEA) and Toronto Public Health.

The ten contaminants included in this report – asbestos, benzene, 1,3-butadiene, cadmium, chromium, dioxins, formaldehyde, polycyclic aromatic hydrocarbons (PAHs), tetrachloroethylene, and trichloroethylene – were selected for their potential to be present in both Toronto's indoor and outdoor environments as well as for their carcinogenic potential. Pesticides and electromagnetic fields (EMFs) related to power lines and radio towers were not included because their health effects have been the subject of previous reports prepared by Toronto Public Health.

Comments:

(a) Cancer Incidence and Mortality in Toronto

Cancer is second only to circulatory disease as the leading cause of death in Toronto. It caused more deaths than respiratory disease, diabetes, accidents, injuries, and AIDS combined. Between 1991 and 1995, cancer was responsible for an average of 4,620 deaths each year in

Toronto. While increased cancer incidence and mortality are associated with aging, approximately 40% of new cancer cases and 30% of cancer deaths occur in Toronto residents who are between the ages of 20 and 64.

Cancer in childhood is rare but it is the most common cause of death due to disease in the age range of 1 to 14 years. While there has been a significant improvement in the survival rate of children with cancer in the last twenty years, there has been no consistent decrease in the incidence of childhood cancers in Canada.

(b) Cancer and the Environment

It is very difficult to prove that environmental exposures to chemical and physical agents are causing cancer because of the difficulties involved in estimating personal exposures and because of confounding exposures such as second-hand smoke. There are, however, many reasons to believe that environmental exposures contribute to the incidence of cancer in the general population. A number of "known and probable human carcinogens" are present in outdoor air and in other media to which the general population is regularly exposed. Among urban residents, gradients of air pollution levels frequently correspond to area differences in the risk of lung cancer. And in communities with large point sources of carcinogens, where adjustments have been made for tobacco and occupational exposures, the risk of lung cancer is proportional to the proximity of the household to these point sources.

Several studies have examined associations between proximity to streets with high density traffic and the occurrence of childhood cancers including leukemia. It is believed that residents on streets with high traffic density experience chronic exposure to the carcinogenic components of vehicle exhaust such as PAHs, benzene and 1,3-butadiene. Several of these studies, which took into account exposures such as parental smoking, have demonstrated a strong and statistically significant association between high traffic neighborhoods ($\geq 20,000$ vehicles per day) and childhood cancers including leukemia.

The results of the ten-year Harvard Six Cities epidemiological study conducted by Dockery and colleagues suggest a much higher relative risk for lung cancer from air pollution than most previous studies. This study had the benefit of air monitoring results for the entire period in which the population was followed as well as detailed information about confounding factors such as smoking habits. These researchers estimated that lung cancer mortality could increase by 14 to 20% for every $10 \mu\text{g}/\text{m}^3$ increase in long-term exposure to respirable particulates ($\text{PM}_{2.5}$) or inhalable particulates (PM_{10}). The air levels of inhalable particulates in the six cities studied ranged from a low of $18.2 \mu\text{m}/\text{m}^3$ to a high of $46.5 \mu\text{m}/\text{m}^3$ while the average daily level of inhalable particulates in Toronto ranges from 19.7 to $23.9 \mu\text{g}/\text{m}^3$.

(c) Cancer and the Workplace

Many of the well-established chemical carcinogens have been identified through studies of workers who have been exposed in occupational settings. Workers can experience prolonged and/or intense exposures to chemical and physical agents that are found in low levels in the environment. The International Agency for Research on Cancer (IARC), an agency of the World

Health Organization (WHO), recognizes 87 chemical, biological and physical agents as “known human carcinogens”, another 63 agents as “probably carcinogenic to humans”, and another 233 agents as “possibly carcinogenic to humans”.

Estimating the contribution of occupational exposures to cancer incidence is controversial and complex because of the dearth of information related to occupational exposures. Estimates range from a low of 4% to a high of 20%. Cancer Care Ontario (CCO) has been citing 9% as the proportion of cancer deaths attributable to occupation on the basis of a report published by A.B. Miller in 1992. By applying the 9% figure to Toronto’s statistics, it can be estimated that approximately 400 cancer deaths per year in Toronto may be the result of workplace exposures.

(d) Cancer Classification of the Ten Contaminants

There is strong evidence that indicates that nine of the ten contaminants selected for this study can induce cancer in humans when inhaled. Three regulatory agencies - IARC, the United States Environmental Protection Agency (US EPA) and Health Canada - have classified nine of these contaminants as “probable” or “known” human carcinogens. There is less agreement among the three regulatory agencies on tetrachloroethylene (also known as perchloroethylene) which is classified as a “probable human carcinogen” by IARC, a “probable or possible human carcinogen” by the US EPA, and “unlikely to be carcinogenic to humans” by Health Canada. Until there is greater clarity on the carcinogenic potential of tetrachloroethylene, Toronto Public Health regards it as a “possible or probable human carcinogen”. A number of the ten contaminants selected also present a cancer concern when ingested. This is particularly clear for dioxins, some PAHs, benzene and 1,3-butadiene.

(e) Environmental Emissions and Exposure Data

The review of available emissions release data suggests that there are huge gaps in our knowledge about the sources of toxics released within the City’s boundaries. Environment Canada’s National Pollutant Release Inventory (NPRI) focuses primarily on large point sources only, when in fact, many of the emission sources within Toronto are mobile sources such as cars and trucks, areas sources such as residential heating, and small and medium-sized commercial, industrial and institutional point sources.

Relatively good data are available on the levels of the selected carcinogens present in outdoor air although Toronto-specific data is missing for several contaminants. Information about contaminant levels in indoor air in residential and public places is very scarce. Air sampling conducted for formaldehyde indicates that it may be present in residential indoor air at levels that are ten times higher than the air levels associated with a one in a million cancer risk. For several of the contaminants examined, such as formaldehyde, polycyclic aromatic hydrocarbons (PAHs), 1,3-butadiene, tetrachloroethylene and trichloroethylene, indoor air can be the pathway of greatest exposure, and indoor air levels can vary significantly depending upon the activities undertaken, and the building materials, furnishings and consumer products used. For these reasons, indoor air quality should be considered as a research priority for Toronto Public Health in the coming year.

The knowledge gaps for occupational exposures are more severe than for the environmental exposures. Currently, there is no publicly available information on occupational exposure levels experienced in Ontario workplaces. The Ontario Ministry of Labour used to systematically collect exposure information on selected chemical and physical agents for Ontario workplaces but this data has not been collected for several years. The older data are currently being transferred into a new database and were not available for this report. Without proper exposure data, it is not possible to estimate the burden of illness associated with occupational exposure to carcinogens. Nor is it possible to ensure that workers are being adequately protected from them.

(f) Health Assessment – Environmental Exposures

While the contaminant levels in Toronto's outdoor air are not higher than those found in other large urban centres, the data suggest that nine of the ten carcinogens (all 10 contaminants except tetrachloroethylene) examined in this report tend to be present in Toronto's outdoor air at levels that approach or exceed the air levels considered tolerable (ie. those associated with a one in a million excess cancer risk). A number of the carcinogens can also be found in indoor air at levels approaching or exceeding the levels considered tolerable (ie. formaldehyde, benzene, 1,3-butadiene, trichloroethylene and polycyclic aromatic hydrocarbons). Several can also be found in food products, soil, and lake sediments.

Two of the ten carcinogens – benzene and polycyclic aromatic hydrocarbons (PAHs) have been measured in outdoor air at levels that are ten times higher than the exposure levels considered tolerable and should be given high priority by the City for actions that will reduce emissions. The transportation sector is likely the most significant source of emissions for both these contaminants within the City. The City should also request that the Ontario Ministry of the Environment and Health Canada move quickly to establish air standards for PAHs to drive improvements in air quality.

Two additional carcinogens – asbestos and chromium (VI) – could be present in Toronto's air at levels that are one or two orders of magnitude (ie. ten to one hundred times) greater than those that correspond to a one in a million cancer risk. For these carcinogens, Toronto-specific data were not available and a range of air levels from urban centres in Canada was used. Environment Canada and the Ontario Ministry of the Environment should be asked to provide Toronto-specific data for these two carcinogens so they can be prioritized for emissions reductions accordingly.

Estimates of the levels of dioxins taken into the body indicate that most residents of the Great Lakes Basin (which includes residents of Toronto) are being exposed to levels of dioxins that are within or above the range at which adverse health effects may be expected. Ingestion of food is the most significant pathway for exposure for dioxins, which are released as unintentional by-products from the incineration of medical and municipal wastes, the burning of diesel fuel in vehicles, and to a lesser extent, the burning of wood in fireplaces. Dioxins have been identified for “virtual elimination” by a number of national and international agreements. For these reasons, the City should give high priority to the development of a strategy that supports their virtual elimination.

(g) Health Assessment – Occupational Exposures

Estimates derived with the CAREX model indicate that a significant number of Toronto workers may be exposed to PAHs in the transportation sector, tetrachloroethylene in clothing manufacturing and dry-cleaning, formaldehyde in clothing and furniture manufacturing, chromium in a variety of sectors, benzene in whole/retail/restaurants/hotels and the personal services sectors, and asbestos in wholesale/retail/restaurants/ hotels, above typical outdoor air levels (see Table 1). Very little is known about the level of exposure in many of these situations. There is no systematically collected publically available information on current occupational exposure levels to contaminants in Ontario workplaces. The City should request that the Ontario Ministries of Labour and of Health and Long-term Care and Cancer Care Ontario prioritize these carcinogens and industrial sectors for investigation to determine the extent and level of worker exposure.

The published occupational exposure data that is available (which is based on workplaces in the United States) indicates that workers can be exposed to these carcinogens at levels that are several orders of magnitude (ie. 100 to 10,000 times) greater than the exposure levels deemed “tolerable” for environmental exposures. While workers are potentially exposed for fewer hours per day, fewer days per week and fewer years than is assumed by regulatory agencies for lifetime environmental exposures, this difference would only justify a 5 to10-fold increase in the exposure levels deemed “tolerable” for workers. It is also true that the working population does not include many of the more vulnerable members of society such as young children, the sick, and the elderly. However, the working population does include men and women who intend to become parents and women who are pregnant or breast-feeding, and the scientific literature does suggest childhood cancer is linked to occupational exposure of both parents before conception and of mothers during pregnancy.

(h) Pollution Prevention as a Strategy

Many of the carcinogens examined in this report present a health concern to both workers and members of the public. Some carcinogens such as formaldehyde, trichloroethylene and tetrachloroethylene present a hazard to workers when they are used to manufacture or treat consumer products. In addition, they can present a hazard to members of the general population when they off-gas or vapourize from consumer products during use (eg. formaldehyde from plywood). Other carcinogens, such as PAHs, 1,3-butadiene and formaldehyde, can present a hazard to both workers and members of the general population when they are emitted from vehicles operated on fossil fuels. Others, such as chromium and cadmium, can present a hazard to people using them in the workplace as well as to members of the general population when they are released into the air or water or disposed into landfill sites.

Pollution prevention strategies that aim to reduce or eliminate the contaminant at source can produce public health benefits for people whether they are at work, at home or outdoors. Given the fact that people in industrialized societies are exposed to low levels of thousands of different chemical and physical agents simultaneously, that the toxicity of many of those substances are not known, and that very little is known about the interactions between contaminants on the

human body, it is prudent to target those contaminants with both high exposure potential and high cancer risk in workplaces and the environment for priority emissions reductions wherever possible. These include the key carcinogens assessed in this report.

Table 1: Major Industrial Sectors with Greatest Number of Workers Potentially Exposed to the Ten Contaminants in Toronto Based on CAREX Modelling

Contaminant	Sector with Greatest Number of Potentially Exposed Workers	Number of Workers
Asbestos	Construction	1240
	Wholesale and retail trade and restaurants and hotels	4846
1,3-Butadiene	Manufacture of plastic products	116
Benzene	Wholesale and retail trade and restaurants and hotels	6059*
	Personal and household services	8123*
	Land transport	247
Cadmium	Manufacture of plastic products	298
	Manufacture of other non-metallic mineral products	638
	Non-ferrous metal basics industries	374
	Other manufacturing industries	230
Chromium	Manufacture of textiles	1060
	Printing, publishing and allied industries	365
	Manufacture of plastic products	326
	Manufacture of fabricated metal products	617
	Manufacture of machinery except electrical	494
	Manufacture of transport equipment	287
	Personal and household services	734
Formaldehyde	Manufacture of clothing apparel, except footwear	1794
	Manufacture of furniture and fixtures	4846
PAHs	Manufacture of clothing apparel, except footwear	842
	Iron and steel basic industries	295
	Wholesale and retail trade and restaurants and hotels	569
	Land Transport	29469
	Personal and household services	861
Tetrachloroethylene	Manufacture of clothing apparel, except footwear	41148
	Printing, publishing and allied industries	284
	Construction	406
	Personal and household services (includes dry cleaners)	1957
Trichloroethylene	Personal and household services	196

* Given that smoking (a significant source of benzene indoors) is now prohibited in Toronto workplaces, these estimates likely over-estimate the potential for benzene exposure in these two sectors at this time.

Conclusions:

This report summarizes the findings and conclusions contained in the Toronto Public Health report appended, entitled: "Ten Key Carcinogens in Toronto Workplaces and Environment". The ten carcinogens selected for study include asbestos, benzene, 1,3-butadiene, cadmium, chromium (VI), dioxins, formaldehyde, polycyclic aromatic hydrocarbons (PAHs), tetrachloroethylene and trichloroethylene. Much of the data in both reports has been drawn from a technical report prepared on contract by ToxProbe Incorporated.

The report has shown that Toronto residents can be exposed to the ten carcinogens through different environmental pathways, including indoor and outdoor air, and food. Existing data suggest that nine of the ten carcinogens are present in outdoor air at levels that approach and frequently exceed the air levels deemed "tolerable" by regulatory agencies. Two of the carcinogens, PAHs and benzene, are present in outdoor air at levels that are ten times higher than the air levels that correspond to a one in a million cancer risk, and should be given priority for action by the City. Another two, chromium (VI) and asbestos, may be present in outdoor air at levels that exceed those deemed tolerable and should be targeted for further investigation. At present, there is insufficient data available on the emission sources of these carcinogens so that it is difficult to identify the specific sources that contribute most to Toronto's airshed.

The study has demonstrated that indoor air can be the pathway of greatest exposure for several of the carcinogens selected. Existing data demonstrate that formaldehyde can be detected in indoor air at levels that exceed the air levels associated with a one-in-a-million cancer risk. Given the scarcity of data on indoor exposure levels in homes and public places, and the high potential for exposure from this pathway, it is recommended that Toronto Public Health consider indoor air quality as a research priority.

Intake levels estimated for dioxins indicate that exposure by ingestion from food products hover around the intake levels at which adverse effects may be expected. Therefore, it is recommended that the City give high priority to actions that support their virtual elimination.

The technical report has documented that there is no publicly available information on current occupational exposure levels to contaminants in Ontario workplaces. Modeling estimates indicate that a significant number of workers may be exposed to PAHs, tetrachloroethylene, formaldehyde, chromium (VI), asbestos and benzene in Toronto workplaces. A review of occupational exposure data published in the United States suggests that workers can be exposed to the selected carcinogens at levels that are hundreds or thousands of times higher than those deemed tolerable for lifetime environmental exposures. The City should liaise with Cancer Care Ontario and the Ontario Ministries of Labour and Health and Long-term Care to ensure that occupational exposure to carcinogens gain greater attention and action.

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List of Attachment:

- (1) Ten Key Carcinogens in Toronto Workplaces and Environment: Assessing the Potential for Exposure Report