Methodological Challenges on the Surveillance of Health Effects of Outdoor Air Pollution
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Final Workshop Report

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Introduction

In many cities of Latin America and the Caribbean air pollution is a major public health problem. Exposures to the types and concentrations of air pollutants commonly found in urban areas of the Region are linked to an increased risk of mortality and morbidity from respiratory and cardiovascular diseases (PAHO, 2005).

Increased awareness of the effects of air pollution in populations residing in urban areas underscores the importance of defining populations at risk, characterizing exposures to ambient air pollutants and quantifying the adverse effects of these exposures on human health.

Epidemiologic surveillance is the ongoing systematic collection, analysis, and interpretation of health data, essential to the planning, implementation, and evaluation of public health practice, closely integrated with the timely dissemination of this data to those who need to know (Last, 2001). Surveillance data provides information for stakeholders in support of decision making processes. It assists in establishing the needs for public health actions and assessing the effectiveness of programs.

Through the implementation of surveillance systems the evolution of a health event is systematically monitored to estimate its magnitude of occurrence, detect trends in occurrence over time – including outbreaks, and assess effects of control programs. Traditionally the health event under surveillance consisted on determining the mortality or morbidity of a certain disease. This concept has been expanded to include surveillance of risk factors, and with regards to environmental health, exposure and hazards (Corvalan, 2000).

In relation to outdoor air pollution, air quality monitoring represents an environmental hazard under surveillance. Monitoring data describe the concentrations and trends over time of a set of air pollutants in a defined geographic area. More recently, the surveillance of health effects associated with air pollution, such as mortality and morbidity from respiratory and cardiovascular diseases, has been proposed.

The PAHO conducted a technical meeting to bring together the experiences of countries from the Region that are developing surveillance of health effects of air pollution and to discuss the methodological challenges involved, including the selection of appropriate indicators. The following is a summary of Regional experiences and of the main elements to be considered when a surveillance of health effects of air pollution is being planned.
Some elements of surveillance systems: definition, objectives, and results

As mentioned earlier epidemiologic surveillance is the ongoing systematic collection, analysis, and interpretation of health data, essential to the planning, implementation, and evaluation of public health practice, closely integrated with the timely dissemination of this data to those who need to know (Last, 2001).

The objective of “traditional” surveillance is that of describing disease occurrence within a certain geographic location with regards to person, time, and place. Surveillance provides the means to determine the magnitude of a public health problem. Its data is used to estimate the frequency of disease occurrence which is used to identify vulnerable population subgroups, assess changes in disease patterns over time, and compare disease occurrence between population subgroups. These analyses assist in establishing the needs for public health actions.

Generally, the frequency of the event under surveillance is reported as an absolute measure of disease occurrence. The measures more commonly estimated are incidence or prevalence rates or mortality rates. These are an expression of the frequency with which an event occurs in a defined population in a specified period of time. The use of rates rather than number of cases is essential for comparisons between and within populations and at different periods of time. The main components of a rate are the number of events in a specified period (numerator) and the average population during the period (denominator) (Last, 2001).

Often reporting of the event under surveillance is obligatory, such endorsement promotes a more comprehensive reporting of cases in the area under surveillance, thus, improving the accuracy of the estimated rates.

Surveillance is a form of descriptive epidemiology, its main goal is to describe disease occurrence. The exploration of correlations between disease and a causal agent are conducted with other type of study designs such as case-control or cohort studies. Surveillance data, thus, serves as the basis for the formulation of hypothesis that could be later tested with these other studies.

When prevention or control programs have been implemented to address public health problems surveillance is a useful tool to estimate the impact of such actions over time.
What are health effects of air pollution?

Exposure to air pollution has been associated with a variety of adverse health effects. Respiratory and cardiovascular effects attributed to short- and long-term exposures as well as development of pregnancy-related outcomes has been reported (Table 1) (WHO, 2006).

Table 1. Health effects attributed to short and long–term air pollution exposures

<table>
<thead>
<tr>
<th>Effects attributed to short-term exposures</th>
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<tbody>
<tr>
<td>• Daily mortality</td>
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<tr>
<td>• Respiratory and cardiovascular hospital admissions</td>
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<tr>
<td>• Respiratory and cardiovascular emergency room visits</td>
</tr>
<tr>
<td>• Respiratory and cardiovascular primary care visits</td>
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<td>• Use of respiratory and cardiovascular medications</td>
</tr>
<tr>
<td>• Days of restricted activities</td>
</tr>
<tr>
<td>• Work absenteeism</td>
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<tr>
<td>• School days missed</td>
</tr>
<tr>
<td>• Acute symptoms (wheezing, coughing, phlegm production, respiratory infections)</td>
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<tr>
<td>• Physiologic changes (lung function)</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Effects attributed to long-term exposures</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Respiratory and cardiovascular disease mortality</td>
</tr>
<tr>
<td>• Chronic respiratory diseases incidence and prevalence (asthma, COPD, chronic pathological changes)</td>
</tr>
<tr>
<td>• Chronic changes in physiologic functions</td>
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<td>• Chronic cardiovascular disease</td>
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<tr>
<td>• Lung cancer</td>
</tr>
<tr>
<td>• Intrauterine growth restriction (term low birth weight, intrauterine growth retardation, small for gestational age)</td>
</tr>
</tbody>
</table>

Source: WHO, 2006

The broad array of health effects associated to air pollution is partly explained by differential susceptibilities to air pollutants which depend on both the host and environmental factors. Host factors include age, health status, diet, and genetics. Environmental factors include the exposure characteristics as well as the individual's housing and neighborhood conditions (WHO, 2006).

Air pollution seems to be more likely to exert adverse health effects on children, the elderly and those with pre-existing respiratory conditions such as asthma or emphysema. Children, for instance, have higher breathing rates than adults and therefore higher intake of air pollutants per unit of body weight. In addition, their immature lungs may have a limited metabolic capacity to address these exposures. (PAHO 2005).

Current evidence indicates that effects of particles on the respiratory and cardiovascular systems may manifest through several, most likely interrelated, pathways involving oxidative stress and inflammation. Evidence is also accumulating in support of an effect of particles on cardiac autonomic control leading to heart rate variability and arrhythmia in susceptible individuals. The mechanisms of effect of other pollutants are not as thoroughly studied. As for
other health effects, such as adverse pregnancy outcomes, the biologic mechanisms remains unclear (WHO, 2006).

The frequency of occurrence of a health effect associated with air pollution exposure is inversely related to its severity (WHO, 2000). Therefore, in the presence of exposure, the proportion of population affected from less severe effects is much larger than the proportion affected by the more severe ones (Figure 1).

Figure 1. Pyramid of health effects associated with air pollution

Premature mortality
Hospital admissions
Emergency room visits
Visits to doctor
Restricted activity / reduced performance
Medication use
Physiological changes in cardiovascular system
Impaired pulmonary function
Sub clinical (subtle) effects

Severity of effect

Proportion of population affected

Source: WHO, 2006

A cause of disease is defined as an antecedent event, condition, or characteristic that was necessary for the occurrence of disease at the moment it occurred, given that other conditions are fixed (Rothman and Greenland, 1998). A cause is termed necessary when it must be present in individuals to develop the disease, yet, its presence does not always lead to disease (Last, 2001).

Many of the health effects associated to air pollution are also associated to other causes. The occurrence of asthma attacks, for instance, has been related to many factors. While one of these is air pollution, other factors include exercise, nutritional status, inadequate access to medication, respiratory infections, genetics, and parental smoking.

Different risk factors play different roles in causation. Air pollution seems to act as a precipitating factor leading to the occurrence of acute effects on already
susceptible individuals. Air pollution could also act as an enabling factor and even at low levels, long term exposures facilitate the development of chronic conditions.

In conducting surveillance of health effects of air pollution the selection of indicators should take into account all of the elements mentioned above.
Surveillance of health effects of air pollution: Regional experiences

The first day of the workshop highlighted the surveillance strategies developed by several countries to address health effects of air pollution. Brazil, Chile, Mexico, and the United States (US) are countries where such surveillance initiatives were implemented. This section consists of a summary of their main characteristics (Table 1).

Population under surveillance

In Chile, the population under surveillance comprised those living in Santiago Metropolitan Area. In Mexico, the population comprised a representative sample of those living in Mexico City. Both of these are densely populated urban areas whose major source of air pollutants is the combustion of fossil fuels.

In Brazil, the surveillance is currently ongoing in six cities, each one located in a different state. The cities and their correspondent states (in parentheses) are: Araucária (Paraná), Camaçari (Bahia), Canoas (Rio Grande do Sul), São Paulo Metropolitan Area (São Paulo), Vitória (Espírito Santo) and Volta Redonda (Rio de Janeiro). Pollutant sources vary. The main sources are industrial facilities, urban traffic, biomass burning, and mining activities.

In US the population under surveillance comprised the New York State, Maine, and Wisconsin residents. Each state will report results separately. The surveillance will be conducted state-wide with a mix of urban and rural areas. With respect to pollutant sources, the air quality data used represents major point sources (large facilities), area sources (gas stations, dry cleaners), on-road and off-road mobile sources, and biogenic emissions.

Period of data collection

Surveillance programs in Brazil and US are in progress. The Mexican program was operative between 1995 and 2001. Chile’s initiative consists of a retrospective analysis of effects for the period 1997-2003.

Health effects under surveillance and data sources

The health effects under surveillance vary. In Chile effects assessed include mortality from respiratory and cardiovascular disease. In Brazil it also includes morbidity. In both countries the effects under surveillance encompasses the assessment of large effects categories with data being obtained from death certificates or hospital discharges records. One difference is that while in Brazil data collection is being conducted prospectively while in Chile this is a retrospective collection of data.

In Mexico and the US morbidity was the health effect of choice and its assessment was based on specific effects rather than the large effects categories used in Brazil and Chile. In Mexico the surveillance was based on
data obtained from personal interviews, while in the US it is obtained from hospital discharge and emergency room records.

**Hazards under surveillance and data sources**

In most of the areas under surveillance there are air monitoring systems in place collecting ambient concentrations of several criteria pollutants (e.g.; particles, ozone, carbon monoxide, sulfur dioxide, or nitrogen dioxide). Data on particle concentrations seems to be available at all sites. The availability of data for other pollutants varies from one place to another.

In the US initiative air quality modeling and satellite data will be used to develop concentrations data for the areas of the state where air monitoring is not available.

**Data analyses**

In contrast to the more traditional surveillance approach, where data analysis consisted on reporting mortality or morbidity rates these initiatives will generate estimates of the risk of disease or death related to air pollution exposures. This involves the use of multivariate regression models.

**Other initiatives**

While this report focuses on surveillance initiatives conducted in the Region there are other initiatives, not analyzed in the meeting, that are worth mentioning. These include: 1) Centers for Disease Control and Prevention National Environmental Health Tracking Program ([www.cdc.gov/nceh/tracking/](http://www.cdc.gov/nceh/tracking/)); 2) Air Pollution and Health: An European Information System ([www.apheis.net](http://www.apheis.net)); and 3) World Health Organization Regional Office for Europe Environment and Health Information System ([www.euro.who.int/EHindicators](http://www.euro.who.int/EHindicators)).
<table>
<thead>
<tr>
<th>Country</th>
<th>Population under surveillance</th>
<th>Period of data collection</th>
<th>Health effects under surveillance</th>
<th>Data sources</th>
<th>Hazard or exposure under surveillance</th>
<th>Data sources</th>
<th>Data analyses</th>
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<tr>
<td>Brazil</td>
<td>Araucária Camaçari Canoas Sao Paulo Metropolitan Area Vitória Volta Redonda</td>
<td>initiated in 2004</td>
<td>mortality from respiratory diseases (children, elderly) hospital admissions for cardiovascular diseases (elderly) hospital admissions for respiratory diseases (children, elderly)</td>
<td>death certificates, hospital discharge</td>
<td>PM$_{10}$</td>
<td>air monitors</td>
<td>time series</td>
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<td>Chile</td>
<td>Santiago Metropolitan Area residents</td>
<td>1997-2003</td>
<td>mortality from respiratory and cardiovascular diseases (all ages)</td>
<td>death certificates</td>
<td>Criteria pollutants</td>
<td>air monitors</td>
<td>time series</td>
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<td>Mexico</td>
<td>a representative sample of Mexico City Metropolitan Area residents</td>
<td>1995-2001</td>
<td>acute effects head cold dry cough wet cough sore throat difficulty breathing hoarseness chest sounds, headache eye irritation eye burning eye itching eye infection</td>
<td>personal interviews</td>
<td>PM$_{10}$, O$_3$, SO$_2$, NO$_2$</td>
<td>air monitors</td>
<td>logistic regression</td>
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<tr>
<td>USA</td>
<td>Maine, New York State, &amp; Wisconsin residents</td>
<td>2001</td>
<td>asthma exacerbations (children, elderly)</td>
<td>hospital discharge, emergency department</td>
<td>PM$_{2.5}$, O$_3$</td>
<td>air monitors, air quality modeling, (satellite data – in the future)</td>
<td>case-crossover</td>
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Conceptual and operational challenges

Conducting surveillance to address health effects of air pollution poses many challenges. The following is a list of elements that should be considered when the development of such a surveillance system is being planned.

1. There is not a standard surveillance model to address health effects of air pollution.

A look at the Regional experiences showed that a variety of approaches were implemented. The choice of model depended on many factors including availability of health and air pollution data requirements.

- Data Sources

Surveillance can be either active or passive. An active surveillance refers to the direct, systematic ascertainment (or follow-up) of individuals to determine the occurrence of the event in question. Information is usually collected by means of structured personal interviews or self-administered questionnaires at specified time intervals.

Conducting personal interviews is resource intensive. Although, information obtained through this mean is usually more complete and specific to the surveillance goals.

In Mexico City, an active surveillance system operated between 1995 and 2001. Daily collection of health effects from personal interviews was conducted on a sample of residents living within a 2-km radius of the air quality monitoring stations of the Mexico City Basin. On average, 290 interviews were conducted on a daily basis for the entire Basin which included 74,000 homes. The sample was expanded during high-pollution periods (Sanchez-Carrillo, 2003).

Passive surveillance, in contrast, consists on receiving reports about the event in question as it manifest in the target population. That is, as individuals request medical attention in hospitals, emergency rooms or outpatient clinics or death is registered in death certificates. A notification form is normally employed to ensure consistency of the reporting process.

This method requires less resources, however, the use of data that has been generated for purposes other than research has some limitations. When integrating or comparing similar data from different sources there may be differences in diagnosis, recording, and reporting. Hospital and emergency room records exclude mild cases of the event that did not require medical attention. Also, data from secondary databases may not be representative of the exposed population or not be available for the event of interest.

Another issue with using secondary databases is that of timing, since these data is not usually available on present moment. Data from records is
always assessed with some delay and may not be good for predictions, just to look at temporal variations (Choi, 2000).

With the exception of Mexico, countries used a passive surveillance approach for data collection. In Brazil, data compilation was prospective, while in Chile and USA it was retrospective.

- **Data analyses**

As mentioned earlier in the document, the type of data analysis most commonly used in “traditional” surveillance is the estimation of absolute measure of disease occurrence. That is incidence or prevalence rates or mortality rates.

In conducting surveillance of health effects of air pollution the sole estimation of absolute measures of disease occurrence may mask the true relation between air pollution and health effects, thus, requiring more complex analysis.

Early last century, markedly increases in mortality and morbidity followed short-term episodes of extremely high levels of air pollution (WHO, 2006). Frequency distributions of pollutants concentrations and numbers of deaths served to corroborate those correlations very clearly.

After reductions in air pollution concentrations along the second half of the last century, air pollution no longer seemed to pose harmful health effects. In fact, studies conducted during the 1960s and 1970s suggested that air pollution levels of that time were safe. It was later, with increasing computational capacities, which in turn aided the development and application of more sensitive statistical techniques, that it was showed that health effects where occurring at lower levels (WHO, 2006). That is, frequency distributions were no longer capable of showing a correlation between air pollution and health at levels thought to be safe.

The surveillance of health effects of air pollution needs, then, to encompass collection of both health and pollutants data and the estimation of measures of association such as the rate ratio rather than mortality or morbidity rates. Regional experience did just that since data analysis consisted on the estimation of measures of association. Mexico used logistic regression models to estimate the association between air pollution and the events under surveillance. Chile and Brazil are using time-series approaches, and in the US the use of case-crossover methods is being planned.

Time-series techniques estimate the influence of temporal variations, usually daily variations, in air pollutants concentrations on mortality or morbidity. These statistical models link the daily counts of health events in a geographically defined population with daily measures of air pollution and other time-dependent variables. These are population-based, retrospective analyses (WHO, 2006).
Conducting analyses of health effects of air pollution requires the implementation of sophisticated data analysis techniques. Trained staff and appropriate software is essential.

It also requires the collaboration of institutions generating air quality data. In addition, staff training needs include the ability to manipulate air pollution data and transform it for the analysis.

2. Choice of indicator variables

Usually, the rationale for developing a surveillance system is the suspicion that a certain disease is highly prevalent in a population and that it is important to prevent or reduce its occurrence. Some motives to implement a surveillance are a high lethality rate such as the one reported for the avian flu, or the diminished quality of life and major healthcare costs associated with chronic diseases such as cardiovascular disease or cancer. In these instances, the choice of indicator variable is the disease in question.

Surveillance of preventable risk factors for highly prevalent diseases, like obesity and smoking, also plays an important role in public health practice. Inducing changes towards healthier habits and behaviors is a major component of primary prevention. In these instances, the choice of indicator variable is the habit or behavior in question.

Environmental pollutants are also risk factors for disease, although, the rationale to put into operation a surveillance of health effects associated to environmental exposures is developed differently. It is based upon reports that a population has been exposed to an environmental agent which is known to produce an adverse health impact. Its role, thus, is to provide evidence on the occurrence of specific health effects that are associated with the exposures in question.

In conducting a surveillance of health effects on environmental pollution a necessary steps in choosing indicator variables is to have a good understanding on the exposure circumstances of the target population as well as of the characteristics of the indicators.

- Understanding exposure conditions

  The target population in a surveillance must consist of the exposed individuals. For this reason, it is essential to have a good understanding of the exposure potential of the population of concern. An incorrect classification of exposure may lead to the generation of false inferences about the problem under investigation.

  An understanding of the concept of dose is central in addressing exposures to environmental pollutants. Dose is the amount of substance available for interaction with metabolic processes or biologically significant receptors after crossing a specific absorption barrier (epidermis, gut, respiratory tract) (Last,
The dose depends on both the concentration of the substance, the duration of the exposure, and its frequency.

In air pollution epidemiology, there are several approaches used to establish the exposure burden. It is important to recognize that, most often, the real dose is not known. The exposure burden is commonly used as a surrogate of dose. The most common approach to estimate exposures to air pollutants is to use data from ambient monitoring stations.

Monitoring data provides information on the concentration of pollutants in the subject’s environment. It is an indirect measure of dose because it refers to the exposure potential. The use of personal air quality monitors or of biologic markers, representing intake and absorbed dose respectively, are better approximations of dose. These methods are, however, resource intensive and not feasible to apply to very large populations.

Air pollution tend to vary within a geographic area, leading to different exposure potential in individuals living within the same area. Some sources of variation include meteorologic patterns and spatial distribution of pollutant’s sources.

- **Characteristics of health indicators**

Once the exposure has been understood it is important to identify what is reported by the scientific literature on its health effects. The selection of health indicators ought to rely on the best scientific knowledge available.

As shown previously, the current scientific literature has reported a broad array of effects associated to air pollution. As mentioned, this is partly explained by differential susceptibilities to air pollutants which depend on both the host and environmental factors.

Some surveillance experiences from the Regions such as those conducted in Brazil and Chile opted for mortality as the outcome of choice. Mortality data is routinely registered and reported in most populations in a fairly standardized approach facilitating its use (WHO, 2006).

Surveillance experiences of Mexico and the USA, and also Brazil, used morbidity data. In Mexico, data for the surveillance was generated through personal interviews. In USA and Brazil, it is being obtained from secondary databases. Hospital admissions and emergency room data is also registered and reported in many populations. Other standardized sources of data are seldom available.

As a general rule health indicators should be simple, easy to obtain, and affordable. It is for these reasons that availability of data is the main driver in the selection of indicators. One disadvantage is that using secondary sources of data constrains the selection of indicators to what is available and not to what is most desirable.
Indicators should also originate from good quality data. As mentioned previously, there could be problems with secondary databases. When the use of either mortality and morbidity records is being planned an evaluation should be conducted to assess relevance and completeness.

In the absence of good quality data, primary data collection should be considered. Evidently, the feasibility to collect data will depend on available resources. Panel studies or sentinel surveillance are some designs that may be implemented to address morbidity when primary data collection is required.

It was mentioned, that in the presence of exposure, the proportion of individuals with less severe health effects is much larger than the proportion of those with more severe ones. In selecting indicators is important to consider the frequency of occurrence of the health effect. It is also essential to consider the size of the target population and the strength of the association. Attainment of power, that is, the ability to detect statistically significant results when they exist is determined by these factors.

Indicators are expected to covary with the presence of the risk factor of concern. Actually, elimination of the risk factor should lead to reductions of the effect. As we mentioned earlier, different risk factors play different roles in causation, and it is important to understand these differences when selecting indicators of effect. For instance, it has been hypothesized that air pollution may act as a precipitating factor and also as an enabling factor. Maybe effects attributed to short-term exposures, where air pollution is more likely to act as a precipitating factor, better depicts the correlation.

In selecting indicators it is essential to consider the multifactorial nature of the health effects related to air pollution exposures. There are a number of other risk factors also linked to disease causation. Often the effect of these, as suggested by the strength of the measures of association reported in epidemiologic studies, is even larger than those observed for air pollution.

When there are competing causes of the health effect that are highly prevalent in the target population, the indicators may not be specific to the risk factor in question. When compared to others, a “traditional” surveillance approach is incapable of separating the effects of air pollution from those related to the other risk factors. Therefore, this approach may lead to the generation of incorrect inferences about the effects of air pollution.

3. **Reflections on reporting**

In planning a surveillance it is essential to identify what is the most appropriate frequency of reporting. This is related to both the event under surveillance and the methods used to implement this surveillance.

The surveillance of infectious diseases, for instance, involves the conduct of a fast and continuous collection, analysis, and interpretation of data. Reporting is most commonly done on a weekly basis.
The surveillance of risk factors, on the other hand, is best conducted through annual population-based prevalence surveys. Habits and behaviors take longer to modify and weekly data collection would not show any substantial changes in response to prevention actions.

Regional experiences implemented the surveillance of health effects of air pollution through population-based cross-sectional studies to investigate effects attributed to short-term exposures. These generated estimates the influence of temporal variations in air pollutants concentrations on mortality or morbidity for a specific time-period.

The methods used in the Regional experiences lead to the reporting of a risk estimate rather than weekly number of events or annual prevalence rates. One question that comes up is whether this methodology is appropriate to generate periodical risk estimates, like annual or bi-annual ones, and try and plot these to address changes over time.

To begin with, the length of the series should be long enough to guarantee statistical power. For smaller population the generation of risk estimates may require several years of data. Another important matter is the variability on the risk estimates that is due to random error. If periodical estimates were to be compared, it would be difficult to separate the variation that is due to random error from the one related to a reduction associated with prevention actions. In air pollution epidemiology the latter is very important to keep in mind because the strength of the association is relatively small.
Summary Remarks

- Population-based “traditional” surveillance has an invaluable role in public health practice. The collection and assessment of health data provide support to public health authorities to make evidence-based decisions. There are methodological limitations when using this approach to address health effects of air pollution. These should be well understood and addressed.

- The systematic collection of hazards information, such as the ambient concentrations of air pollutants, is also necessary nowadays. This includes data on ambient concentrations of pollutants, emission inventories, and sources.

- Air quality standards are based on human data, that is, results from epidemiologic and human (toxicologic) exposure studies. The foundation for regulation and enforcement should be attainment of these standards and the surveillance of health effects is no proven substitute to it.

- The application of sensitive statistical techniques is required to address health effects of air pollution. Maybe studies of short-term exposures such as panel or case-crossover studies should be done in lieu of the “traditional” surveillance.

- The choice of health effects indicators is dependent on many factors including data availability and quality of data, available resources, and attainment of statistical power.

- Health effects and air pollution data needed to address health effects of air pollution are not contained within one sector or institution. Multi-disciplinary and multi-institution collaboration needs to be sought.

- Addressing the social and cultural factors related to the production of air pollution which are not normally assessed as part of the health effects or economic analysis may be advantageous. This could provide further information with which to gain a better understanding of the relation between human health, environmental factors and prevention actions.
References


## Appendix I – Workshop agenda

### Methodological Challenges on the Surveillance of Health Effects of Ambient Air Pollution

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Activity</th>
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<tr>
<td>28/11/2005</td>
<td>08:30h</td>
<td>Opening Remarks – Introduction of participants</td>
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<tr>
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<td>09:00h – 13:00h</td>
<td>Presentations</td>
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<td>International and Latin American Context of Health Effects of Air Pollution</td>
<td><strong>Introduction to the Meeting and Latin American Perspective</strong> – Mildred Maisonet</td>
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<td><strong>Burden of Disease due to Urban Air Pollution</strong> – Aaron Cohen</td>
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<td>Surveillance in Latin America – Country Experiences</td>
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<td>Brazil - Development of an Environmental Health Surveillance related to Air Quality within Brazil’s Health Reporting System – Guilherme Franco Netto</td>
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<td>Mexico – Surveillance of Acute Health Effects of Air Pollution in Mexico City – Victor Borja</td>
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<td>Other Initiatives Related to the Assessment of Health Effects of Air Pollution</td>
<td><strong>Center for Disease Control and Prevention (CDC) – Public Health Air Surveillance Evaluation Project (PHASE)</strong> – Vickie Boothe: <strong>Teleconference</strong></td>
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<td>International Study of Asthma and Allergies in Childhood – Prevalence Studies: The ISAAC in Latin America – Javier Mallol (cancelled)</td>
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<td>Swisscontact – Development of Air Monitoring Capacities in Central and South America – Jon Bickel</td>
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<td>Brazil – Multi City Study of Air Pollution and Health Effects in Latin America – Nelson Gouveia</td>
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<td>Discussions</td>
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<td>29/11/2005</td>
<td>09:00h – 13:00h</td>
<td>Working Groups</td>
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<td>13:00h – 14:30h</td>
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<td>14:30h – 17:00h</td>
<td>Plenary Sessions</td>
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<td>17:00h</td>
<td>Closing Remarks</td>
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</table>
Appendix II – List of participants

**BRAZIL**

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HACON, Sandra  
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Ministry of Health

LINHARES, Ana Cristina Soares  
Ministry of Health

MARTINS, Lourdes Conceição  
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