

**STATISTICAL COMMISSION and  
ECONOMIC COMMISSION FOR EUROPE**

**CONFERENCE OF EUROPEAN STATISTICIANS**

**Joint ECE/Eurostat Work Session on Methodological  
Issues of Environment Statistics**  
(Ottawa, Canada, 1-4 October 2001)

**COMMISSION OF THE  
EUROPEAN COMMUNITIES**

**EUROSTAT**

**WORKING PAPER No. 18**

**ORIGINAL: ENGLISH**

**PROPOSED CORE ENVIRONMENTAL PUBLIC HEALTH INDICATORS  
FOR THE U.S. – MEXICO BORDER REGION**

Paper submitted by the WHO/PAHO Collaborating Centre on Environmental and Occupational Health Impact Assessment and Surveillance<sup>1</sup>

**Abstract:** This paper proposes a rationale for and a selection of a list of candidate indicators to comprise a core group within the monitoring and surveillance program currently being developed for public environmental health in the US/Mexico border region. This region covers a 100 km-wide area on each side of the border spanning 4 American and 6 Mexican states. This area is characterized by accelerated urbanization and industrial development, high rates of migration and poverty, within a context of fragile ecosystems and deficient sanitary and public health infrastructure.

Using a two-step/paso-doble approach involving science-based and use-based criteria, the selection process was guided by the World Health Organization DPSEEA framework for indicators, regional objectives for public health intervention and pragmatic concerns originating from practitioners. The paper includes the appropriate definitions and proposes a list of 50 indicators for environmental and occupational public health surveillance.

---

<sup>1</sup> Prepared by Pierre Gosselin MD MPH, WHO/PAHO Collaborating Centre on environmental and occupational health impact assessment and surveillance at CHUQ; Chris Furgal PhD, CHUQ Research Center; Alfonso Ruiz, DVM, PhD, Chief, El Paso Field Office, PAHO; Luiz A.C. Galvao, MD, MSc, Program Coordinator, HEP/HEQ, PAHO

## Table of Contents

	Page
<u>1. Introduction:Environmental Public Health Indicators for the U.S.- Mexico Border Region</u> .....	3
<u>2. Defining Environmental Health and Environmental Health Indicators</u> .....	3
<u>3. Frameworks for Indicator Identification and Selection</u> .....	5
<u>4. Indicators and Program Objectives</u> .....	8
<u>5. Defining the Audience(s)</u> .....	12
<u>6. Criteria for Indicators: Selecting the right ones</u> .....	13
<u>7. Choosing a Set of Core Indicators</u> .....	14
<u>8. Core Environmental Public Health Indicators for the U.S. - Mexico Border Region</u> .....	16
<u>9. Results of the El Paso Workshop: A Draft List of Core Indicators</u> .....	16
<u>10. References</u> .....	22

### List of Tables

Table 1. Draft list of core environmental public health indicators for the U.S. – Mexico Border region as developed at the El Paso Workshop, July 26-27, 2001. ....	19
---	----

### List of Figures

Figure 1. Examples of Commonly Used Frameworks for Indicator Organization (adapted from Eyles and Furgal, 2000).....	6
Figure 2. The Driving Forces, Pressure, State, Exposure, Effect, Action (DPSEEA) model of WHO (WHO, 1995:5).....	7

## 1. Introduction: Environmental Public Health Indicators for the U.S.-Mexico Border Region

Following the La Paz Agreement in 1983, the U.S. – Mexico Border XXI Program was established to bring together various American and Mexican agencies and departments responsible for the region bordering these two countries. The Program was established to help guide activities in the region towards a goal of sustainable development through the protection of human health and the environment, and the appropriate management of natural resources in both countries. The mission of the Border XXI program is to “achieve a clean environment, protect public health and natural resources, and encourage sustainable development along the U.S. – Mexico border” ([www.epa.gov/usmexicoborder/ef-about.htm](http://www.epa.gov/usmexicoborder/ef-about.htm)).

This U.S. – Mexico border region is characterized by conditions impacting the health of border communities such as: rapid urbanization; increased industrial/manufacturing development and associated occupational risks; an increasing number of youth, working adults and children resulting from migration; a high rate of poverty; lack of sufficient drinking water supplies and inadequate drinking water quality; inadequate treatment and disposal of domestic and industrial wastewater, solid and hazardous industrial wastes; and improper handling and storage of pesticides. All of these situations are occurring in a region without the accompanying development of health and environmental infrastructure and capacities to effectively deal with these issues at the local and region levels ([www.yosemite1.epa.gov/oia/MexUSA.nsf/](http://www.yosemite1.epa.gov/oia/MexUSA.nsf/)), one of them being environmental public health surveillance.

This paper proposes a rationale and selection of a list of candidate indicators to comprise a core group within the monitoring and surveillance program being developed by the Border XXI Environmental Health Working Group.

## 2. Defining Environmental Health and Environmental Health Indicators

The U.S. Department of Health and Human Services (2000) defines environmental health as: *“...those aspects of human disease, and injury that are determined or influenced by factors in the environment. This includes the study of both direct pathological effects of various chemical, physical, and biological agents, as well as the effects on health of the broad physical and social environment, which includes housing, urban development, land-use and transportation, industry and agriculture.”*

This definition is very similar to that of the WHO Charter, which was adapted as the European Charter on Environment and Health, which defines environmental health as:

*“...(environmental health) includes both direct pathological effects of chemicals, radiation and some biological agents, and the effects (often indirect) on health and well-being of the broad physical, psychological, social, and aesthetic environment, which includes housing, urban development, land use and transport.”* (Johnson, 1997)

Some definitions have also included the processes or actions related to dealing with environmental health issues. The WHO definition of Environmental Health Services (1989) states:

*“Environmental health is comprised of those aspects of human health and disease that are determined by factors in the environment. It also refers to the theory and practice of assessing and controlling factors in the environmental that can potentially affect health.”*

As most of the means for such activities are usually out of the control of public health agencies, this also serves to highlight the essential role of close cooperation with environment, transport, natural resources and other agencies at the local, state or federal levels.

The Canadian Federal, Provincial and Territorial Advisory Committee (1996) identifies at least five key determinants of health:

- Living and working conditions
- Physical environment
- Personal health practices and coping skills
- Health services
- Biology and genetic endowment.

In our consideration of environmental health those determinants most relevant to links between public health and the surrounding environment should be considered. To attempt to measure all factors in these relational chains would be too consuming with regards to time and funds.

Therefore, measurements that are indicative of the relationships and impacts we are concerned about, or interested in, are chosen as “indicators” of the status of these relationships and their impacts.

Briggs et al. (1996) defines environmental health indicators as:

*“an expression of the link between environment and health, targeted at an issue of specific policy or management concerns and presented in a form which facilitates interpretation for effective decision making”.*

Similarly, the PAHO Workshop on Binational Environmental Health Indicators (PAHO, June 2000) stated *“..an environmental health indicator is defined as one that provides data on environmental quality (water, air, soil) and its impact on public health.”*

**Summary:**

As it is more comprehensive in including industry and agriculture, and more specific through inclusion of disease and injury, we propose to use the definition of environmental health adopted by the U.S. Department of Health and Social Services (2000) with an addition for the notion of health and well-being, and the extension of the discipline aspects of the definition to include the prevention, correction and control of...  
...environmental public health risks. The proposed adapted definition would read as follows:

*“...those aspects of human health, disease, injury and well-being that are determined or influenced by factors in the environment. This includes the study of*

both direct deleterious effects of various chemical, physical, and biological agents, as well as the effects on health of the broad physical and social environment, which includes housing, urban development, land-use and transportation, industry and agriculture.

Environmental health also refers to the professional practice of evaluating, preventing, correcting or controlling environmental risks and promoting the benefits for communities and individuals.”

The definition for environmental health indicators proposed by Briggs et al. (1996) is more action oriented and appears to fit better the notion of health surveillance and is therefore adapted and recommended for use here. An environmental health indicator is:

“an expression of the probable link between environment and health, based on prior scientific knowledge, targeted at an issue of specific public policy or management concerns and presented in a form which facilitates interpretation for effective decision making”.

### 3. Frameworks for Indicator Identification and Selection

Implicit in the understanding that an indicator represents a link within a phenomenon of interest (e.g. the relationship between human health and the environment) is some conceptual interpretation of this phenomenon based on previous knowledge, experimentation, or understanding. These models or frameworks of our comprehension of, for example, the link between water quality and human health, often represent the components in a linear fashion to more clearly articulate causal connections. With the understanding that the situation is often more complex in reality, the model provides a framework for the organization and development of indicators at various points along the chain (Kjellstrom and Corvalan, 1996).

One of the most recognized of these “frameworks” of understanding is that of the “Pressure - State – Response” model developed by the Organization for Economic Co-operation and Development (OECD). This model is based on the understanding that certain pressures on a system (e.g. release of toxic substances in the natural environment), cause certain forms of stress on components within the system (e.g. pollution of organism tissues or compartments of air, soil or water), influencing their status (e.g. levels of substances in organisms, or environmental compartments) which then elicit various forms of response (e.g. organism mortality). From this basic model a number of others with varying levels of specificity in the chain describing links within the phenomenon have been derived and used for a variety of purposes (Figure 1).

COMMONLY USED INDICATOR FRAMEWORK COMPONENTS				
	PRESSURE		STATE	RESPONSE
CONDITION	STRESS			RESPONSE
ISSUE	INDIRECT DETERMINANT	DIRECT DETERMINANT	HEALTH STATUS	RESPONSE

DRIVING FORCE	PRESSURE	STATE	EXPOSURE	EFFECTS	ACTIONS
	PRESSURE	EXTERNAL DOSE	INTERNAL DOSE	EFFECTS DEATH	ACTIONS
	HAZARD	EXPOSURE	EFFECT	INTERVENTION / RESPONSE	

Figure 1. Examples of Commonly Used Frameworks for Indicator Organization (adapted from Eyles and Furgal, 2000)

\* Bold outline indicates where most effort has been focused in indicator development and use in the past.  
Sources:OECD (1976); Corvalan et al. (1996); Von Schrinding (1997); Friend and Rapport (1979); Environment Canada, WHO (1996), NRC (1999)

All of the commonly used frameworks have similarities in their basic organization and utility for a variety of purposes. A model developed at the World Health Organization took a broader approach to include macro driving forces in the pressures on health and the environment. The model was called the “Driving Forces-Pressures-State-Exposure-Effects-Action (DPSEEA) framework”. The DPSEEA model (Figure 2) is useful as it covers the full spectrum of potential forces and resulting actions and brings together professionals, practitioners, and managers from both environmental and public health fields to help orient them in the larger scheme of the problem. The DPSEEA model has been adopted by the Ciudad Juarez Workshop in June, 2000, and is quite similar to the USEPA framework.

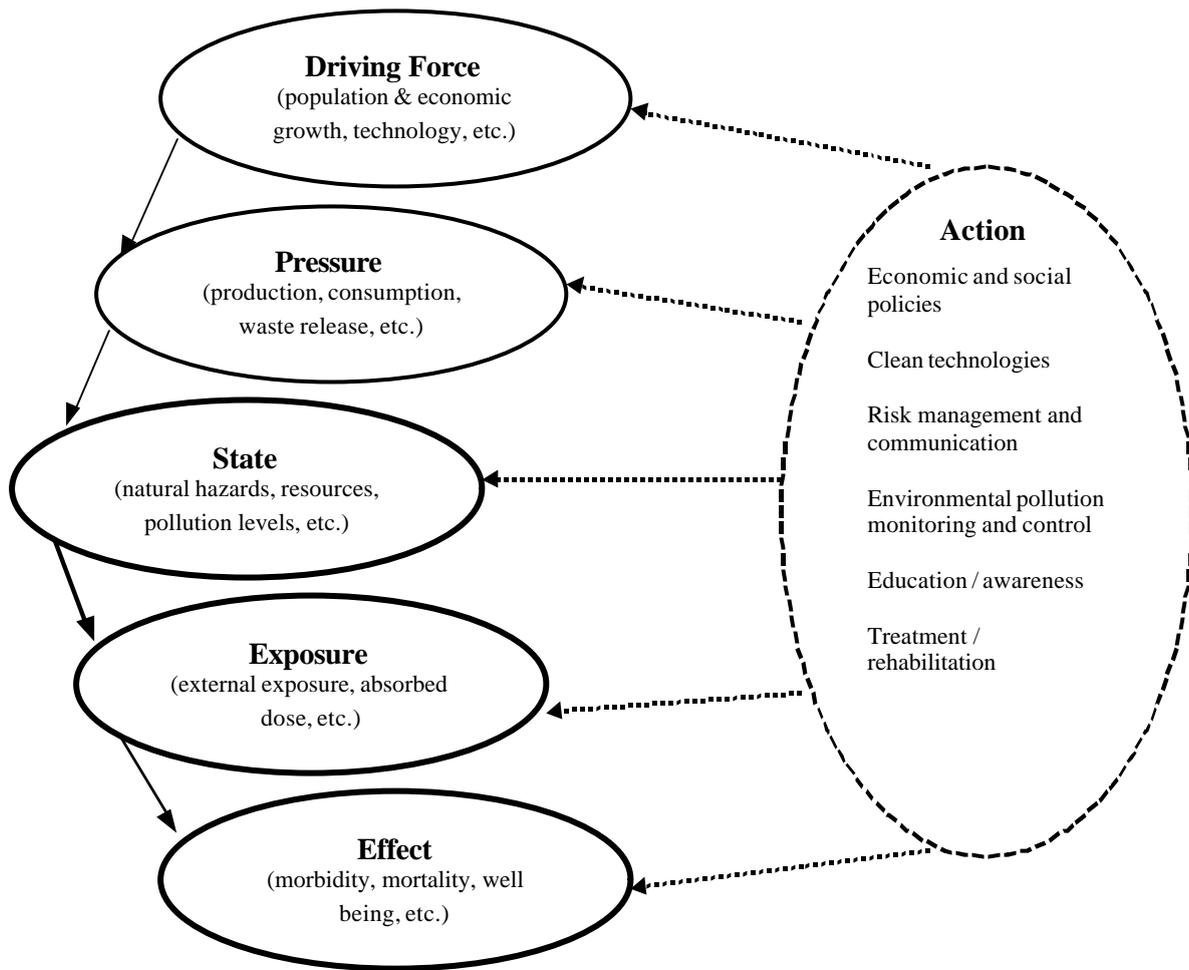


Figure 2. The Driving Forces, Pressure, State, Exposure, Effect, Action (DPSEEA) model of WHO (WHO, 1999:5)

These frameworks have been developed to serve the purpose of emphasizing the level of specificity or desired focus of a specific monitoring program, and thus the adaptation of the framework is dictated by the goals and objectives of the monitoring exercise, often based upon a specific agency's legal mandate. Therefore, depending upon the differences in the focus of two hypothetical programs, what one program defines as a "hazard", may refer to another program's "external dose", or what one program terms a "pressure", another may define as a "state".

The terminology and degree of detail (number of compartments explicitly identified within the phenomenon being studied) developed in the framework is dictated by the program goals and objectives. The number of "steps" or "compartments" in the framework used must be justified, and the terminology explicitly defined in order for the framework to serve its purpose as a helpful tool in identifying and selecting indicators to retain in a monitoring program. We must also remember that the biases present in the understanding and conceptualization of the phenomenon, and thus the construction of the model, are retained in the indicators derived from this understanding. In basic models such as those of the "Pressure – State – Response" form, these biases are included in the mechanistic and causative approach taken which has difficulties

accounting for exceptions to this form of understanding of the phenomenon, feedback interactions, cumulative impacts and non-linearities (Eyles and Furgal, 2000).

**Summary:**

Frameworks are tools to be adapted to fit the needs of their users. In the case of environmental health, the cause-effect relationships are particularly complex in terms of the sources and diversity of contaminants, interactions with genetic and lifestyle determinants, or other causes of disease/injury. The WHO-developed DPSEEA framework brings together environment and health representatives in action-oriented surveillance. It also offers flexibility to include action at the most appropriate and effective levels of intervention in a given context. It is also very similar to the framework adapted by the environmental agencies involved in the Border Program. For these reasons the DPSEEA framework is recommended for use here.

**4. Indicators and Program Objectives**

The purpose of indicators varies considerably with the phenomenon being studied, the relationships within that phenomenon, and the objectives of the program for which the indicators are being used. So the indicators retained in a monitoring program should be dictated by the specific goals of the program. As Briggs (WHO, 2000: 1.3) states:

*“The fundamental assumption is that indicators are intended to serve a purpose. They must therefore be fit for their purpose. This implies that we know what purpose we want them for and who will use them in order to define and design them accordingly. To be useful, indicators must relate to an issue of current or future interest or concern. Different issues raise different questions and different users have different interests and needs. To provide this information the indicator must be interpretable. This means that we must know what differences or changes is the indicator meant for. In addition, indicators should be accurate, so that they provide an undistorted picture of the condition of interest. At the same time, they should be transparent – be readily understood by the users. Crucial for the design of good indicators is the “denominator”.*

As many programs have multiple purposes, a balance between the various types of indicators is expected, so that there is some information that can be used, for example, to measure compliance with recognized standards, to track regular changes in environmental health situations, to provide warning of potential future environmental health hazards, etc. The mission, goals and strategies to achieve the goals of the U.S. – Mexico Border XXI Environmental Health Working Group, which must be considered in selecting appropriate types of indicators for environmental health monitoring in this region, include:

**Mission:** to achieve a clean environment, protect public health and natural resources, and encourage sustainable development along the U.S. – Mexico Border.

**Primary Goal:** to promote sustainable development in the border region by seeking a balance among social and economic factors and protection of the environment in border communities and environmental areas.

**Strategies to achieve goal:** ensure public involvement, build capacity and decentralize environmental management, ensure inter-agency cooperation.

Further, more specific goals of the program are stated and include:

1. Improve public health in the border region
2. Increase efficient use and protection of water resources
3. Develop infrastructure for water treatment and solid waste treatment and disposal
4. Meet national air quality standards
5. Increase information exchange and cross border notification capacity
6. Increase communities abilities to response to environmental emergencies in the border region
7. Increase local technical capacity
8. Increase effective enforcement and compliance with U.S. – Mexico environmental laws  
(USEPA Border XXI web site, 2000)

The Mexican ministry of health has recently presented some environmental health indicators based on available data (Rauda, 2000); however it does not address their specific purpose in relationship to objectives. Currently, a review of organizational and government web sites provides limited information on Mexican specific goals and initiatives within the Border region. A group of US agencies (CSTE, CDC, ATSDR, EPA) are developing a core group of environmental health indicators that can be used by state and national agencies to track adverse health events related to the environment. The proposed uses for these indicators include: (1) Establish surveillance of status or trends to (a) prevent known or suspected adverse public health events associated with environmental exposures, (b) detect new adverse health events associated with environmental exposures, and (c) provide efficient and consistent reporting mechanisms; (2) Enhance program and policy development, planning and evaluation by: (d) tracking program goals and objectives, (e) supporting existing programs, and (f) guiding research initiatives; and finally (3) To build core capacity and relationships with other agencies (USEPA, January 2001).

Central to the goal of protecting public health in relation to environmental influences, we add to this list some basic objectives for consideration in order to further refine the overall goal of improving public health. They are:

- Protect “at risk” populations (e.g. tribal and *colonia* communities);
- Protect “at risk” individuals as defined by their susceptibility and exposure patterns (children, women of child bearing age, elderly, those with high occupational exposures, farmers);
- Address priority public health issues with known relationship to an environmental determinant (based on various criteria including burden of risk, rates of increase/incidence, emerging public health issue).

Further, environmental health objectives should be identified in a way that supports and allows for an incremental implementation of indicator collection over time. As Briggs (WHO, 1999) states, *"the DPSEEA framework should be seen as an aid, not a straight-jacket; it needs to be adapted and modified according to circumstance"*. This approach, of using basic public health priorities, orients our efforts in indicator development towards the State, Exposure, Effect and Action components of the DPSEEA framework. Through identifying short term (e.g. water quality), mid-term (e.g. air quality) and long term (e.g. occupational risks) priority issues, indicators can be identified and collected at the appropriate scales as the program develops and matures and capacity to conduct the work evolves.

A comprehensive yet focused set of specific objectives for the surveillance and monitoring activities of the Environmental Health Working Group would ideally be a combination of those listed above. To move to a more realistic and much smaller core, we believe objectives should first be defined (at least in a preliminary manner) in order to ensure that appropriate indicators are identified and retained within the list of "core indicators".

What also must be defined here is the objectives of the surveillance exercise which is conducted to generate data to help achieve the program goals and mission. The Canadian Federal/Provincial/Territorial Committee on Environmental and Occupational Health define health surveillance as:

*"...the tracking and forecasting of any health event/outcome or health determinant through the ongoing collection of high-quality data, the integration, analysis and interpretation of that data into surveillance products (reports, advisories, warning etc.), and the timely dissemination of those resultant surveillance products to those who need to know. Surveillance products are produced for a specific and predetermined public health purpose or policy objective and to be classified as true health surveillance all of the above activities must be carried out. "*

The *primary activities in health surveillance* are to detect, and monitor health-related indicators while the *value of surveillance* is in the analysis and interpretation of data which may trigger a response to a critical health issue. Important to also note in this definition is the inclusion of surveillance products (summary data, full status reports, data tables, etc.) and the timely dissemination of this material to influence the decision-making process for public health services but maybe more importantly in the Border region, for development issues (land planning, regional priorities, budgets, human and institutional resources). In order to fulfill their objectives, the activities of the surveillance program must include the production and distribution of its products in formats adapted for its various audiences; in other types of business this function is called marketing.

**Summary:**

We suggest to further enhance the general objectives stated in the Border XXI Program in the form of public health driven objectives in the following traditional domains of environmental health: WATER, AIR, FOOD, WASTES, NATURAL / TECHNOLOGICAL RISKS AND MULTIPLE EXPOSURES, and RESOURCES (financial, human and institutional). This terminology is still very much in use in everyday environmental health practice. These domains of exposure have also been recently confirmed as occurring in approximately the same order as presented above, according to the most important contributors to the burden of disease from environmental sources, using DALYs (for Disability Adjusted Life Years which cover morbidity and mortality) as a common denominator (World Bank, 2000). The preliminary suggestions below are based on our imperfect reading of the materials provided.

**Overall Goal:** Protect and promote public health in the U.S. – Mexico Border region as it pertains to environmental and occupational health.

We suggest initial implementation of the first 3 objectives below and gradual implementation of the fourth according to availability of information and resources.

**General Objectives** (apply to each thematic category):

1. Assess exposures and risk levels (including behaviours and perceptions)
2. Assess human biological exposure and levels of related diseases and populations at risk (mortality, morbidity, perceptions)
3. Identify priority groups for intervention (vulnerable, highly exposed)
4. Reduce exposure / diseases through:
  - adapted information and support for several audiences
  - protective and control measures
  - preventative / corrective measures aimed at individual, community, state/federal levels
  - promotion of adapted behaviours and institutional responses

**Preliminary Specific Objectives (by category)****WATER:**

Identify at-risk / vulnerable sub-populations, geographic locations and individuals based on available data

Increase availability and access to drinkable water from [insert current level]% to [insert target level]% by [insert target date]

Decrease water related diseases and injuries

**AIR:**

Identify at-risk / vulnerable sub-populations for indoor air pollution (including consideration for tobacco and fuel use)

Decrease # of days exceeding air quality standards from [insert current # here] to [insert target # here] by [insert target date here]

Decrease heat/cold related deaths

Decrease pollution related emergency consultations for asthma, bronchitis and cardio-pulmonary diseases

**WASTES:**

Toxic: assess exposures of at-risk groups (air – volatile organic compounds, POPs; waterborne/water table contaminations) \*

(\*consideration of hazardous wastes to include chemical and microbiological risks related to such things as tires as breeding sites for mosquitoes for vector-borne diseases – e.g. dengue)

**FOOD:**

Estimate the burden of disease from chemical and microbial food contamination

Preliminary assessment of key factors in risk chains for microbiological food chain contamination

**NATURAL / TECHNOLOGICAL RISKS AND MULTIPLE EXPOSURES:**

Assess levels of risk to humans from exposure to natural and technological risks and multiple exposures \*

Assess/decrease poisonings by chemicals in children

Assess/decrease poisonings by pesticides in agricultural workers

Assess exposures (occupational and non-occupational) to heavy metals and POPs on a population basis and identify priority groups

\* natural risks including such things as floods, hurricanes, earthquakes, etc.

\* technological risks including such things as chemical spills, fires, explosions, etc.

**RESOURCES (Financial, Human and Institutional):**

Develop more specific, quantifiable objectives for: academic training, on the job training, tools such as information technologies, emergency response teams, expertise and support

Consider priority groups, locations, and needs for development.

Reinforce some specific basic environmental health services (e.g. PAHO Essential Functions, 2000; Environmental Program Framework, 1993)

**5. Defining the Audience(s)**

Implicit in the program objectives is the identification of target audience(s). This audience identification includes groups at a more macro scale (political officials and the general public) as well as groups at a more micro scale (environment and public health practitioners and managers at the local, state and national levels). The identification of these groups includes both the users of the information generated by the indicators and the ultimate recipients of the program achievements (e.g. the general public as a recipient of enhanced environmental health protection).

As most programs have multiple purposes, they will have multiple users and audiences for the indicators and information they generate. As the indicators must have true meaning to these audiences in order to be effective (e.g. the public health official must understand the importance of a specific indicator in order to use it in an argument for the need for a specific intervention effort), it is useful to explicitly identify them in the development of any monitoring and surveillance program, and whenever possible, involve them in the identification and selection of indicators. From our understanding of the current state of affairs in the Border region, there is a clear need to positively influence political officials in order to receive their commitment to a second phase of the program for the longer term (i.e. 10 years). This situation usually requires a focus on:

- Indicators at macro scales
- Indicators that can show progress over short periods of time (2-3 years) to encourage sustained funding
- Indicators that political officials can share with the general public.

**Summary:**

We suggest two broad categories of audiences (and surveillance products) for the objectives of the environment public health surveillance program for the U.S.-Mexico Border region. These two groups are:

1. (Macro audience) – political officials and general publics in the U.S.-Mexico Border region;
2. (Micro audience) – environment and public health practitioners and managers in the U.S.-Mexico Border region.

This implies that adapted materials and media should be used for these audiences.

**6. Criteria for Indicators: Selecting the right ones**

The purpose of indicator selection and the fact that any such selection will appear, for other purposes incomplete, must be kept in mind. In order to guide indicator identification and selection, criteria must be chosen that ensure that the appropriate indicators are retained to meet the desired goals. The literature is rich in potential criteria and indicators for a variety of purposes. It is essential that each program develops its own set of criteria, however, some are common and should be included in most, if not all cases. We propose a rationale for filtering the candidate indicators in which we apply two categories of criteria (science-based and use-based; Eyles et al. 1996) which include consideration of practical program needs criteria such as those discussed by Rump (1996).

***Scientific Criteria***

Scientific criteria are generic to the issue of scientific quality and according to Eyles et al. (1996) include:

1. Data availability and suitability

2. Indicator validity (assessed in a variety of forms, such as face, construct, predictive, convergent, content, theoretical, empirical validities):
3. Indicator representativeness
4. Reliability (is a prerequisite to validity);
5. Ability to disaggregate. OECD (1976) identify disaggregation by ascribed groups (e.g. age, sex, race, region), well-being (e.g. years of education, employment status) and contextual (e.g. size of community, type of occupation) characteristics.

### ***Use Based Criteria***

The development and selection of use-based criteria depends on the goals of the indicator application or surveillance program and the context within which they are used (e.g. socio-economic and political environment of the U.S.-Mexico border region). Use-based criteria present in the literature vary from the general (e.g. are they feasible to collect ?) to the very specific (e.g. what is the valency of the indicator (potential to carry political and social 'punch')). As Eyles et al. (1996) state, as much clarity as possible is required in the relationship between the indicator and the purpose for which it is used. Some of the commonly reported use-based criteria include:

1. Feasibility (are they already collected and available and if not, how feasible is it to collect new information considering cost, ease and time for collection, capacity to gather data, etc.);
2. Resonance with audiences in relation to topics covered (importance of the indicator measurement to those affected);
3. Manageability (a manageable number is needed to attain specified goals, but this number must not be too cumbersome or unruly to comprehend and manage mentally);
4. Balance (a rough balance among all phenomenon of interest should be represented);
5. Catalyst for action (those that act as a catalyst to drive action of one form or another are highly valued).

### **Summary:**

Until now, most efforts on indicators in the Border region have focused on the science-based criteria with (apparently) less attention being paid to their use. We suggest to move towards a more use-driven selection process founded on the program public health objectives as suggested and the feasibility of indicators to meet these objectives in ways that are achievable in the U.S. – Mexico Border region.

## **7. Choosing a Set of Core Indicators**

Many authors have discussed the fact that differences in data collection practices and capacities across local, regional, national and international scales, as well as the lack of agreement, in many cases, on how to address environmental health issues and set priorities, and the jurisdictional differences to do so, makes the selection of a single, universally applicable set of indicators unrealistic and undesirable. Further, regional differences in many of the factors influencing good indicator development and selection need to be considered and respected in multi-regional

monitoring programs. It is for these reasons and others that the WHO/PAHO has proposed the development of “core” indicators for environmental and health surveillance programs along with the addition of “optional” indicator sets allowing regions to address specific differences and meet specific needs.

As defined in the PAHO/WHO June workshop report (2000):

Core indicators: are likely to be available at a state level and should be part of a basic environmental health program;

Optional indicators: states may choose to use them depending on individual needs, priorities, data availability, or which may be indicators with environmental components but which may already be under the jurisdiction of other programs in state health departments.

Ideally, the minimal number needed to meet program goals should be retained however, this is difficult to determine (Eylenbosch and Noah, 1988). Miller (1956) suggests  $7 \pm 2$  as the “magic” number for mental management and comprehension. Therefore, it is suggested that a small number of categories (5-9) with a small number of indicators in each (5-9) be retained and then a core set (of about 50 indicators) selected as a balance from all categories to be collected in all regions involved in the program.

#### **Summary:**

We propose to work from established lists of indicators already developed and available through other organizations and agencies (PAHO, USEPA, USDHHS, Briggs developed for WHO). The science-based criteria are therefore prominent in choosing these lists and thus are well incorporated here. We therefore, stress more use-based criteria to drastically reduce the working lists of indicators and choose those most appropriate and carrying most weight for the specific needs of the U.S. – Mexico Border region. We propose to filter the indicators through the following use-based criteria:

- Catalyst for action in public health programs within the border region;
- Resonance with daily needs and priorities of public health and environment practitioners and managers activities and responsibilities (including laws, regulations, needs and concerns);
- Resonance with political officials and the general public and their needs and concerns.

Following the first iteration of review and selection, we suggest that priorities be established among chosen indicators through consideration for:

- Feasibility and manageability of data collection / integration for indicators in light of existing and likely available financial and human resources / capacities;
- Ease of implementation over time (short term, mid-term and long term scales)
- Synergy and complementarity for Border XXI program and / or other Border initiatives and national / federal surveillance systems.

Once completed, a final check of the core list of indicators should be done and

adjustments made accordingly, considering:

- Face validity: does the list make sense ? is it likely to be what is needed for action ? is it sustainable in the mid and long terms ?
- Reduce redundancy among indicators
- Strive for a balance among the different compartments of the DPSEEA framework
- Balance action based indicators among (a) providing service and access, (b) ensuring the quality of the service, and (c) increase public knowledge of this service

Through the review process indicators will be ranked based on their subjective score on each criteria such that an overall ranking of all indicators per theme can be used to identify priority indicators to retain for a core list. This process will be guided and recorded through the use of a spreadsheets (Appendix A, Appendix B). We suggest that about 5 indicators for each of the 4 exposure categories be retained, for a total of around 20 core indicators; remaining indicators can then be classified as optional indicators and ranked for implementation.

## **8. Core Environmental Public Health Indicators for the U.S. - Mexico Border Region**

Considering the material presented above, and that highlighted in the box summaries, we have outlined a process and conducted an initial review of available indicator sets to propose a core for the Environmental Health Working Group of the U.S. – Mexico Border Program. The basic purpose of this selection is aimed at the goal of providing information to support the better functioning of environmental health services in this region. The primary scale at which we have targeted the application of this objective is that of the local – regional environmental health level, which is the sister cities areas for the Border region: the people working at these levels represent the foundation of any environmental health improvement in the future. Following this logic, it is essential first to have a clear understanding of the needs of individuals and agencies at this level, as well as a precise comprehension of what types of information these individuals and agencies can (i.e. capacities) and will use. We feel that although a good general understanding of these situations may be known (PAHO, Encuesta, 2001), a more detailed assessment would be helpful. A user needs assessment, similar to some recent reviews conducted in Canada (e.g. Federal/Provincial/Territorial CEOH, 2000) on such issues as access to data, availability of information, etc. is therefore recommended for this region to support the development and implementation of an appropriate surveillance program, including its training and tools component.

## **9. Results of the El Paso Workshop: A Draft List of Core Indicators**

A two-day workshop convened on July 26 and 27, 2001 at the El Paso field office of the Pan American Health Organization brought together Mexican and PAHO representatives (Appendix C) to review the initial draft of this document, the definitions and criteria herein, and follow a process for indicator ranking and selection. Suggested adaptations to the document have been included in the draft presented here. Indicators compiled from recognized organizations (PAHO, USEPA, USDHHS, Briggs developed for WHO) were used to form the basis for indicator selection. All indicators were then scored by each participant based on the first 3 criteria (see below) and all indicators receiving scores of 8 and 9 from any one participant were retained.

**Criteria used to score initial list of indicators:**

***Catalyst for action in public health programs within Border XXI initiative***

- 3-if related impact or consequences can lead to death directly or in the short term;
- 2-if related impact is potentially severe and/or a large population is impacted;
- 1-if related impact is likely reversible or benign.

***Resonance with public health and environment practitioners and managers***

- 3-if high burden of disease and high level of attributable risk;
- 2-for moderate;
- 1-for low.

***Resonance with political officials and public needs and concerns***

- 3-if perceived as very important in public mind;
- 2-if somewhat important;

These indicators were then entered into a matrix and subjected to the same scoring system based on a second list of 3 criteria (see below). A sum of all participants' scores for each individual indicator was then calculated and the top 2 indicators (receiving greatest cumulative total) for each objective (e.g. Objective 1 – assess exposures and risk levels) in each environmental health category (e.g. air) were then retained for the final draft core list of indicators.

Adjustments were then made to this list based on a final assessment of indicator coverage, balance etc. as outlined in the box on page 19-20. This core list of approximately 50 indicators is presented in Table 1. Through the development of Table 1, participants expressed a specific need to address the issue of occupational exposures and risks in the U.S.-Mexico Border region and thus appropriate indicators were reorganized into this newly identified category as presented in Table 1.

**Criteria used to score indicators retained in Table 1 (following first round review):**

***Feasibility and manageability of collection and integration for U.S. – Mexico Border region***

- 3-if already collected;
- 2-if data collection needs major improvement or if special survey needed;
- 1-if also needs lab data and/or specific epidemiologic investigation.

***Ease of implementation over time***

- 3-if can be implemented in the short term;
- 2-if can be implemented in mid-term (2-3 years);
- 1-if requires long-term for implementation (more than 3 years).

***Synergy and Complementarity for Border XXI Program and/or other Border initiatives and national / federal surveillance systems***

3-if strongly supports the achievement of three or more objectives;

2-if it helps to achieve one to two objectives;

1-otherwise.

**Table 1. Draft list of core environmental public health indicators for the U.S. – Mexico Border region as developed at the El Paso Workshop, July 26-27, 2001.**

	<b>WATER</b>	<b>AIR</b>	<b>FOOD</b>	<b>WASTE</b>	<b>MULTIPLE EXPOSURES</b>	<b>OCCUPATIONAL</b>
<b>OBJECTIVE 1.</b> ASSESS EXPOSURES AND RISK LEVELS (INCL. PERCEPTIONS AND BEHAVIOURS)	Percentage of urban population with potable water through house connections (PAHO E2)  Access to basic sanitation (Briggs)	Number of exceedances days for each ambient air standard (Border)  Proportion of youth 15-19 of age who smoke (PAHO D 30)  Ambient air concentrations for criteria pollutants in each sister city (Border)  Percentage of households using coal, wood or kerosene as main source of heating/cooking fuel (Briggs)	Level of consumption for raw milk  Level of consumption of traditionally preserved food	Number of chemical spills (transportation and fixed facility) EPA 90  Quantities of hazardous waste exported to Mexico for recycling EPA-Env 97	Adequacy of storage for chemicals in households	Pattern of pesticide use (CDC)  Adequacy of storage for chemicals in workplace
<b>OBJECTIVE 2.</b> ASSESS BIOLOGICAL EXPOSURES AND LEVELS OF RELATED DISEASES (MORTALITY, MORBIDITY, PERCEPTIONS)	Diarrhea mortality in children under 5 (Briggs)  Diarrhea morbidity in children under 5 (Briggs)	Incidence of morbidity due to acute respiratory infections in children under 5 (Briggs)  Estimated death rates due to acute respiratory infections in children under 5 (PAHO C11)	# of outbreaks of foodborne illness (Briggs) 86	Incidence of chemical spill related injuries and poisonings EPA 91  Blood/urine concentration levels (95th percentile) for heavy metals in the vicinity of recycling and / or hazardous waste facilities modified from EPA 92	Number of reported poisonings per year in children under 5 (Briggs)  Estimated death rates due to tumors (selected sites) (PAHO C20)  Incidence of birth defects	Incidence of occupational mortality (Briggs)
<b>OBJECTIVE 3A.</b> IDENTIFY PRIORITY GROUPS FOR INTERVENTION (VULNERABLE)	Population access to health services (PAHO E1)  Mortality rate under 5 (PAHO C6)  % of population living in extreme poverty (PAHO B8)  Birthweight					
<b>OBJECTIVE 3B.</b> IDENTIFY PRIORITY GROUPS FOR INTERVENTION (HIGH EXPOSURE)	Degree to which drinking water systems comply to guidelines (CDC)  % of children living in areas served by public water systems that exceeded a drinking water standard or violated treatment requirements (EPA-C; E5)	Percentage of children living in counties in which air quality standards were exceeded (EPA-C; E1)  Percentage of homes with children under 7 where someone smokes regularly (EPA-C; E4)	Proportion of children consuming diets with foods with high level of contaminants	% of women of child bearing age and children living in the vicinity of hazardous waste and recycling facilities  % of population living in noxious fauna and pest infested dwellings	Total 3 of children living in households with inadequate storage of chemicals	Occupational and industrial categories where unsafe, unhealthy or hazardous working conditions may exist

**Table 1. Draft list of core environmental public health indicators for the U.S. – Mexico Border region as developed at the El Paso Workshop, July 26-27, 2001 (cont'd).**

	<b>WATER</b>	<b>AIR</b>	<b>FOOD</b>	<b>WASTE</b>	<b>MULTIPLE EXPOSURES</b>	<b>OCCUPATIONAL</b>
<b>OBJECTIVE 4.</b> <b>REDUCE EXPOSURE/DISEASE</b> <b>THROUGH:</b> -adaptive information support -protective and control measures -preventative, corrective measures (at inds, community, state levels) -promote adaptive behaviours and institutional responses	% of at-risk population being reached by a public health program promoting basic hygiene measures  % of population knowing the quality levels of their drinking water	Implementation of programs that address motor vehicle emissions (CDC)  Schools with indoor air policies that address environmental hazards (incl. smoke and tobacco-free policies) (CDC)  Jurisdictions with laws pertaining to smoke-free indoor air (CDC)	Training of personnel for food supply management and prevention in the chain of risks  Food contamination advisories	% pop with regular waste collection, recycling and disposal (Briggs) 101  % of people living in at-risk areas for hazardous waste that are aware of associated risks and available preventative protective measures  Total mass of solid waste disposed by regular waste services (per yr) (Briggs) 102	Number of sister cities with contingency plans (Border)  Participation of public health officers to environmental impact assessment processes	Public health intervention in occupational health to be determined  # of industries and agricultural plants with emergency health services  # of industries and agricultural plants with occupational accident/injury registry systems

\*This development and implementation of these indicators assumes collection and availability of basic socio-demographic statistics (to be listed in final document)

\*This core list is based on previously available lists to improve comparability with other regions of the country and world

Finally, some recommendations for implementation were made by the participants at the El Paso workshop. They include:

- The program must require full “buy-in” for all components of the surveillance / monitoring program among participating communities. Therefore, no community can participate solely for the interest in one aspect of the program (e.g. water infrastructure).
- In order to ensure data quality and reliability there was an identified need for a QA/QC (quality assurance / quality control) program for laboratory and evaluation services. This requires the appropriate financial and human resources.
- The following time schedule should be used to guide the development and implementation of the program (see below). There is a recognized need to proceed slowly in the initial stages to ensure data quality and to gradually implement all objectives and indicators over time.

**Proposed Steps Following El Paso Workshop:**

August 3 <sup>rd</sup>	Copy of completed draft paper sent to all partners for review and comment
Sept 4 <sup>th</sup>	1 month review period for all partners – comments due
Sept 10-11 <sup>th</sup>	Conference call to discuss comments received

\*Conference call with larger group as required for adaptations to paper

October 15 <sup>th</sup>	Final document including measurement criteria to be completed and distributed to all partners
November (first week)	Local Workshops begin in identified sister cities

Following the first workshop, local input will be used to adapt the process for the local situation and realities and also to further filter indicators to best fit the local situation.

## 10. References

- Briggs, D., Corvalan, C., and M. Nurminen. 1996. Linkage methods for environment and health analysis. UNEP/US EPA/WHO, Geneva, Switzerland.
- Corvalán, C., D. Briggs and T. Kjellstrom. 1996. "Development of environmental health indicators", in *Linkage methods for environment and health analysis. General guidelines*. (D. Briggs, C. Corvalán and M. Nurminen, eds.). Geneva: UNEP, USEPA and WHO, pp.19-53.
- Eylenbosch, W.J. and N.D. Noah (Eds.). 1988. Surveillance in Health and Disease. Oxford University Press, New York, NY. 286 pp.
- Eyles, J., and Furgal, C. 2000. Indicators in environmental health: Identifying and selecting common sets. Paper prepared for the International Joint Commission Conference "Consensus Conference on Environmental Health Surveillance: Agreeing on basic sets of indicators and their future use", Quebec City, October 10-12, 2000. International Joint Commission, Ottawa, ON. ( <http://ottserver1.ottawa.ijc.org/hptf/> )
- Eyles, J., Cole, D., and B. Gibson. 1996. Human health in ecosystem health: Issues of meaning and measurement. International Joint Commission. Ottawa, ON. Canada.
- Federal , Provincial and Territorial Committee on Environmental and Occupational Health. 2000. Steps to Strengthening Environmental and Occupational Health Surveillance in Canada. F/P/T CEOH, Ottawa, ON.
- Federal, Provincial and Territorial Advisory Committee on Population Health. 1996. Report on the Health of Canadians. Health Canada, Ottawa, Ontario.
- Gosselin P. et al. 1991. Feasibility study on the development of indicators for a sustainable society. Final Report to Health and Welfare Canada. Université Laval, Québec.
- Hancock, T., Labonté, R., and R. Edwards. 1999. Indicators that Count ! - Measuring Population Health at the Community Level. Final Report. York University, Toronto, ON.
- International Joint Commission. 1991. A proposed framework for developing indicators of ecosystem health for the Great Lakes region. International Joint Commission, Windsor, Canada. 47 pp.
- Johnson, B.L. 1997. Agency for Toxic Substances and Disease Registry, Atlanta, Personal Communication, as in (2001) An Ensemble of Definitions of Environmental Health, U.S. Department of Health and Human Services, Environmental Health Policy Committee, and Risk Communication and Education Subcommittee.  
<http://www.health.gov/environment/DefinitionsofEnvHealth/ehdef2.htm>

Kjellstrom, T. and C. Corvalan. 1996. Framework for the development of environmental health indicators. World Health Organization, Geneva, Switzerland.

Miller, G.A. 1956. The magical number 7, plus or minus 2. *Psychological Review*, 63: 81-97.

Organization of Economic Co-operation and Development (OECD). 1976. Organization of Economic Co-operation and Development Core set of indicators for environmental performance reviews. A synthesis report by the Group on the State of the Environment. Paris, France.

Pan American Health Organization / World Health Organization (PAHO/WHO). 1993. Environmental Program Framework for Local health Systems in the Americas. Pan American Sanitary Bureau, Regional Office of the World Health Organization, Washington, D.C.

Pan American Health Organization / World Health Organization (PAHO/WHO). 2000. 42<sup>nd</sup> Directing Council, 52<sup>nd</sup> Session of the regional Committee, Provisional Agenda Item 4.11, Essential Public Health Functions. [http://www.paho.org/english/gov/cd/cd42\\_15-e.pdf](http://www.paho.org/english/gov/cd/cd42_15-e.pdf)

Pan American Health Organization / World Health Organization (PAHO/WHO). 2000. Pan American World Health Organization PAHO / WHO Report of the First Binational Workshop on Environmental Health Indicators. Ciudad Juarez, June 607, 2000.

Pan American Health Organization / World Health Organization (PAHO/WHO). 2001. Encuesta Sobre Salud Ambiental (ESA). Infraestructura y Recursos Humanos de los Estados de la Frontera Norte Mexico. Organizacion Panamericana de la Salud, Oficina de Campo, Frontera México-Estados Unidos. El Paso, Texas, 1999-2000.

Rauda, J. 2000. Vigilancia Ambiental e Indicadores de Salud Ambiental. Experiencia en la Vigilancia Ambiental en México.

Rump, P. 1996. State of Environment Reporting: Source Book of Methods and Approaches. Division of Environment Information and Assessment Report No. UNEP/DEIA/TR.96-1, United Nations Environment Programme, Nairobi, Kenya.

United States Environmental Protection Agency (USEPA). 1994. Indicator development strategy. Environmental Monitoring and Assessing Program, EMAP Centre, Research Triangle park, North Caroline. EPA 620/R-94/022.

United States Environmental Protection Agency (USEPA). 2001. About the Border program web site. <http://epa.gov/usmexicoborder/ef-about.htm>

United States Environmental Protection Agency (USEPA). 2001. Border XXI Program homepage. <http://yosemite1.epa.gov/oia/MexUSA.nsf>

United States Environmental Protection Agency (USEPA). 2000. Environmental Public Health Indicators. January 2001, draft.

United States Environmental Protection Agency (USEPA). 2001. Border XXI Program information web site. <http://yosemite1.epa.gov/oia/MexUSA.nsf>

US Dept. of Health and Human Services. 2000. Healthy People in 2010. Conference edition, Volumes I and II. Washington, D.C. January 2000.

Von Schirnding, Y.E.R. 1997. Indicators for policy and decision-making in environmental health. Draft report prepared for the Office of Global and Integrated Environmental Health, World Health Organization, Geneva, Switzerland.

von Schirnding, Yasmin E. 2000. "Health and Environment Indicators in the context of Sustainable Development", paper presented at the *Conference on Environmental Health Surveillance* (October 10-12, 2000), Quebec City.

World Bank. 2000. Report on Disability Adjusted Life Years. <http://wbIn0018.worldbank.org/essd/essd.nsf/GlobalView/HealthandENV.pdf>

World Health Organization (WHO). 1989. Definition of Environmental Health Services as in (2001) An Ensemble of Definitions of Environmental Health, U.S. Department of Health and Human Services, Environmental Health Policy Committee, and Risk Communication and Education Subcommittee. <http://www.health.gov/environment/DefinitionsofEnvHealth/ehdef2.htm>

World Health Organization (WHO). 1993. Definition of environmental health developed at WHO consultation in Sofia, Bulgaria, as in (2001) An Ensemble of Definitions of Environmental Health, U.S. Department of Health and Human Services, Environmental Health Policy Committee, and Risk Communication and Education Subcommittee. <http://www.health.gov/environment/DefinitionsofEnvHealth/ehdef2.htm>

World Health Organization (WHO). 1996. Linkage Methods for Environment and Health Analysis: General guidelines. A report of the Health and Environment Analysis for Decision –making (HEADLAMP) project. WHO, Geneva, Switzerland.

World Health Organization (WHO). 1999. *Environmental Health Indicators: Framework and Methodologies*. Geneva: WHO (WHO/SDE/OEH/99.10).

World Health Organization (WHO). 2000. *Environmental Health Indicators: Development of a methodology for the WHO European region*. (Interim Report, December 18, 2000). Bilthoven, Netherlands: WHO Regional Office for Europe, European Centre for Environment and Health.