

BIOLOGICAL MONITORING OF THE GENERAL POPULATION - THE CEC AND WHO/UNEP APPROACHES

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ABSTRACT

Based on the increasing experience available in the occupational health field which shows that biological monitoring can provide in a number of circumstances a better assessment of the integrated exposure than ambient air monitoring, both Commission of the European Communities (CEC) and World Health Organization/United Nations Environmental Programme, (WHO/UNEP) are undertaking extensive biological monitoring programmes of the general population.

While the approach of the two programmes is different a close cooperation has been established so that they will provide as complementary results as possible.

Both programmes will provide, for the toxic substances to be analysed, information concerning current levels of exposure, trends in exposure levels for both the general population and certain specifically exposed population groups. The quality control component is an essential feature of both programmes.

The CEC programme while limited at the moment to lead measurements in blood is more intensive and already being implemented. In addition to providing the information indicated above, it will assess the results in terms of reference values already agreed by Member States; the exceeding of these reference values imposes on Member States that action be taken.

The WHO/UNEP programme when implemented, will have both a broader geographic coverage (about 10-15 countries) and includes more pollutants (lead in blood, cadmium in blood and kidney, mercury in blood and/or hair, certain organo-chlorine pesticides in mother's milk).

The cooperation between the organizations sponsoring these programmes covers the planning stages, the quality control activities and, hopefully treatment and exchange of results.

In recent years biological monitoring has been playing an increasing role in the assessment of occupational exposure to toxic agents. More and more decisions regarding the continued exposure of a worker to a toxic substance are being made on the basis of biological measurements - concentration of the toxic substance in a body fluid, presence of a metabolite, reversible change of a biochemical parameter. The results of comparative studies between ambient

measurements at the workplace and biological monitoring have shown that biological monitoring can provide in a number of circumstances – in particular in cases of large temporal and spatial variations of air concentration and in cases of sources of intake other than air – a better assessment of the integrated exposure than ambient air monitoring.

In the case of environmental exposure to toxic agents an assessment of the exposure for most of these agents through environmental monitoring requires numerous determinations of these pollutants in air, water, food and even soil. Biological monitoring, as in the case of occupational exposure, permits one to obtain a direct measure of dose or integrated exposure. This type of monitoring is to be considered at par with environmental monitoring, and offering an essential instrument for the monitoring of effects of exposure on health.

Within the general framework of assessing man's exposure to environmental pollutants both WHO/UNEP and CEC are currently undertaking extensive biological monitoring programmes. These activities are carried out by UNEP/WHO as part of the health related component of the Global Environment Monitoring System (GEMS).

To further establish the scientific basis of these programmes the CEC and WHO have organized jointly with the Environmental Protection Agency of the United States an International Workshop on "The Use of Biological Specimens for the Assessment of Human Exposure to Environmental Pollutants", which took place in Luxembourg in April 1977. With respect to biological monitoring the main objectives of the workshop were:

- to assess the types of environmental pollutants and human specimens most suitable for "biological monitoring"
- to examine the state of the art and the technical feasibility of programmes designed to collect, analyse and store samples relative to biological monitoring
- to develop guidelines for sampling, sample preparation, analytical requirements and storage;

The Workshop concluded that for the pollutants and human tissues listed in Table 1 biological monitoring should be feasible at present; the biological specimens to be studied depend upon the specific objectives and design of the programme considered. This is in full agreement with the pollutants and biological specimens selected for both CEC and WHO/UNEP programmes.

THE ORIGIN OF THE WHO/UNEP AND CEC PROGRAMMES

The WHO/UNEP Programme

Following a World Health Assembly Resolution of May 1971 and the establishment of the United Nations Environment Programme, the Twenty-Sixth World Health Assembly requested the Director-General to accord high priority to "the development of systems for the monitoring of pollutants and other environmental factors that may be harmful to health in air, water, food, soil and the working environment". A WHO Meeting of Experts was convened in July

1974 in Geneva to prepare the framework for a WHO Environmental Health Monitoring Programme and it was followed in March 1977 in Geneva by a UNEP/WHO Government Expert Group on Health-Related Monitoring. This Group recommended that a number of pilot studies be undertaken to assess human exposure to, and evaluate the intake of, cadmium, lead, mercury and organo-chlorine compounds in selected population groups in different parts of the world. The Group emphasized the need to integrate the proposed biological monitoring activities with other environmental health monitoring programmes.

TABLE 1
Pollutants and human biological tissues amenable at present to biological monitoring.

Tissues	Pollutants											
	Arsenic	Cadmium	Chromium	Lead	Inorganic mercury	Methyl mercury	Carbon monoxide	Organochlorine pesticides	Polychlorinated biphenyls	Chlorinated solvents	Benzene	
Adipose tissue								X	X			
Blood	X	X		X	X	X	X	X	X	X	X	X
Bone				X								
Brain					X	X						
Expired air							X				X	X
Faeces		X										
Hair	X			X		X						
Kidney		X		X	X							
Liver		X		X		X						
Milk								X	X			
Placenta		X		X								
Teeth				X								
Urine	X	X	X	X	X				X		X	X

It was noted that a number of environmental, food and biological monitoring programmes were already in progress in several countries, and the benefits to be gained by those countries and by GEMS (Global Environmental Monitoring System) from close coordination of those programmes were underlined.

However, in order that the programme might be implemented at an early date, it was agreed that biological monitoring should start on a pilot basis as soon as possible and, if necessary, ahead of environmental and food monitoring. The pilot project has started in September 1978. Negotiations are under way with selected national authorities that will result in the involvement of a limited number of laboratories in all continents.

The CEC Programme

In 1973 the Council of the European Communities adopted a broad programme of action on the environment, calling, in particular, for an objective evaluation of the risks to human health and to the environment from pollution

and for an exchange of information between the surveillance and monitoring networks.

Among the long list of environmental pollutants a number have been chosen for priority investigation on the grounds both of their toxicity and of the current state of knowledge of their significance in the health and ecological fields (among them lead, organohalogen and organophosphorus compounds, sulphur compounds and suspended particulates in air, carbon monoxide and asbestos).

On the basis of this programme the Council of the European Communities by Decision of June 1975 established a common procedure for the exchange of information between the surveillance and monitoring networks of Member States based on data relating to atmospheric pollution based on sulphur compounds and suspended particulates. The implementation of the exchange has been carefully designed to provide an input element for GEMS.

The same year the Commission submitted to the Council a draft Directive on "Biological Standards for Lead and Screening of the Population for Lead", setting forth a biological monitoring programme for blood lead measurements and standards against which the results are to be assessed and action taken. The Council approved, in March 1977, a Directive on "Biological Screening of the Population for Lead" which is to be considered a pilot programme in this field of biological monitoring.

DETAILED DESCRIPTION AND IMPLEMENTATION OF THE PROGRAMMES

Pollutants covered

The following pollutants and tissues to be covered by the WHO/UNEP and CEC programmes are summarized in Table 2. For the CEC programme some countries have indicated their intention of adding cadmium in blood measurements to the required lead in blood measurements. There is still some hesitation in the WHO/UNEP programme regarding the inclusion of mercury and the measurement of the organochlorine compounds in blood.

TABLE 2
Pollutants and tissues covered by the WHO/UNEP and CEC Programmes.

Tissues	Pollutants			
	Cadmium	Lead	Mercury	Organo-chlorine compounds
Blood	WHO/UNEP CEC (?)	WHO/UNEP CEC	WHO/UNEP (?)	WHO/UNEP (?)
Hair			WHO/UNEP (?)	
Kidney	WHO/UNEP			
Milk				WHO/UNEP

Selection of countries and populations to be monitored

In the WHO/UNEP programme it is expected to have from ten to a maximum of fifteen countries participating in the metals component of the project and up to ten countries in the organo-chlorine component. Policemen as a group to be monitored for metals, and lactating mothers as a target group for monitoring of organo-chlorine compounds are considered possible population groups to be selected. Such target groups would be reasonably comparable between different countries. Special risk groups, such as children for lead, and heavy fish eaters for mercury, may also be included. One target population for cadmium will be people in the different age groups who have died from, for example, accidents or other causes of "sudden death". For each metal and for the organo-chlorine compounds about 50–100 samples per country will be analysed during the course of the study. In the CEC programme based on the Directive all nine Member States have to participate. The sampling shall be carried out on:

- groups of at least 100 persons in urban areas with more than 500 000 inhabitants,
- groups of at least 100 persons, insofar as this is feasible, chosen from among people exposed to significant sources of lead pollution,
- critical groups determined by the competent authorities in the Member States.

In each Member State and during each campaign (two campaigns to be carried out separated by a 24-month interval) the number of analyses to be performed shall be 50 or more per million inhabitants. For the urban areas in principle an adult population (equal number of men and women) will be chosen statistically from the electoral register, alongside some children preferably below 11 years of age. In areas near known sources of industrial lead pollution the main group of interest will be children of lead workers living in the vicinity of the lead source. It is expected that a total of 10–15 000 samples will be collected during each campaign.

In the CEC programme the measured blood lead levels will be assessed against a series of reference values, on a percentile distribution (20 µg/100 ml at the 50 percentile level).

It is expected that when the reference values have been exceeded in one or more cases, Member States shall:

- check the validity of the results,
- take action to trace the exposure sources responsible for the levels being exceeded; this shall also include special attention devoted to all individuals with a blood lead level over 35 µg/100 ml,
- take all appropriate measures at the discretion of their competent national authorities.

No such reference values and specifications exist for the WHO/UNEP programme.

Quality control

Both programmes recognize the utmost importance of quality control in view of the serious analytical difficulties which may be encountered in such

measurements. Within the CEC programme, Member States have informed the Commission of the names of the laboratories which they wish to take part in the campaign. The Commission is now running a continuous quality control programme for the forty-plus laboratories which have been designated. With the agreement of national authorities acceptability criteria for the analytical results have been laid down. A similar programme, but most probably with a different concept of acceptability criteria will be established for the WHO/UNEP programme. There will most probably be different protocols for the metal components and for the organo-chlorine compounds. Furthermore questions concerning sample collection, shipment, central supply of materials, avoidance of contamination and degradation will also be considered. In addition the WHO/UNEP programme places considerable emphasis on the training and other aspects of technical cooperation.

THE CEC-WHO/UNEP COOPERATION

Both organizations feel that a close cooperation in this complex field is indispensable. This cooperation was first implemented by organizing jointly the International Workshop in April 1977 in Luxembourg. In addition by participating in each other's planning meetings maximum convergence is obtained taking however into account that the basic objectives of the two programmes are different. The WHO/UNEP programme is aimed at strengthening national health related monitoring programmes as well as obtaining a rather broad and global indication of the exposure levels for several substances, while the CEC programme, concentrated on lead, is aimed at detecting problem areas in the Community for this pollutant and coping with them. One major aspect of the WHO/UNEP programme is to provide technical cooperation in the form of equipment and training to a number of laboratories requiring it. Each organization will use the experience of the other in Quality Control, and some joint quality control exercises might be organized.

Finally by having some of the European Community countries participate in the WHO/UNEP programme, with the same study areas, a direct link for intercomparison purposes between the two activities is envisaged.