

The expert system "DIOXIN": its place in the process of the "case-and-effect" relationships in the "environment-and-public health" system.

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Under existing conditions, when the public attention is strongly attracted to the problems of environmental control, the hygienic science responsibility for the theoretical and methodological level of developments in the field of public health protection has greatly increased.

The leading role in the realization of this task is played by the modern methods of monitoring of adverse factors for the environment and public health.

The poor theoretical developments of the problem of relationships of the type "factors of technogenic characters-and-public health" are often the cause of the fact that the statistic dependence between the environmental changes and the biological response of a human organism can often be revealed only empirically, while it is the realization of the "cause-and-effect" relationship that is of the utmost importance for the prevention and response to critical ecologo-toxicological situations. The long-term chronic effects of chemicals stable in the environmental objects such as polychlorinated dibenzo-para-dioxins and their structural analogs, polycyclic aromatic hydrocarbones and heavy metals play a particular role in human pathology. These have much in common: a long-term period from the initial toxin exposure of an organism till the first clinical sings of disease appear, polymorphism of clinical manifestations, torpidity of the disease course.

The methods for the complex control of the "environment-public health" system state with the subsequent profound investigation of a risk-group may be, in our opinion, conditionally divided into integral (plants, animals and human beings are regarded as biotargets) and factorous (an adverse factor is characterised by it's separate components). The integral methods are good for the timely detection of trouble in a controlled system; the factorous methods are expedient for the estimation of the degree of harmful effects of a definite class of substances on the population.

Due to their extreme toxicity, stability in all kinds of media and wide distribution the polychlorinated dioxins (PCD), dibenzofurans (PDBF) and biphenyls (PBP) are gradually turning to be the most complex and frequent cause of the critical ecologo-toxicological situations. During the previous 10-15 years the particular attention was paid to the cases of sudden environment pollution with the substances of the named classes as a result of incidents at the chlorinated phenols production facilities. Nowadays ecologists and hygienists pay more attention to the cases revealing the environmental pollution with PCD, PDBF and PBP in the process of the long-term

functioning of the facilities, being the constant sources of these substances formation. In the light of these observations we made an attempt (dioxin as an example) to approach the methodology of the working out of the expert systems aimed at the exposure and medical examination of mass human diseases, characterised by slow development of the affection centre, by polymorphism of clinical signs, by complexity of the epidemiological factor recognition. One of the complex problems of the epidemiology of potential mass-exposure centres with the listed above harmful substances is the necessity of revealing among hundred thousands of people those, who should be subjected to further thorough examination. This should be done on the basis of rather non-specific demonstration of chronic intoxication. On this situation it seems most proper to use the computerised technology of population screening. Our expert system "DIOXIN" is intended for physicians working in potential dioxin exposure centres.

The expert system "DIOXIN", possessing the knowledge of highly qualified physicians-expert in this very field, makes it possible outside of a medical establishment according to the clinical signs of the disease to carry out the screening interrogatory of population in order to find out the cases similar to the dioxin intoxication.

The expert system consists of the following elements:

- the control unit and the machine of logic output providing the selection and interpretation of the rules from the knowledge base with the subsequent output of respective conclusions;
- the communication subsystem, providing a simple and convenient dialog interface between a physician and the expert system;
- the unit for the explanation of the obtained results permitting a physician to look through the chains of "speculations" of the expert system, to check the validity of the conclusions made and to study the process of output production in a given object field;
- the data base, filled with facts, rules for facts processing, received from the expert;
- the data base to store the information about the examined population;
- printing of the results of the patients interrogatory from the data base in the form of ACS lists, subjected to a profound (including laboratory) investigation.

The base of knowledge makes it possible to choose one of the following conclusions:

- the data do not correspond to the clinical manifestation typical to dioxin-like substances exposure;
- the data suggest the presence of the dioxin exposure with a larger or smaller coefficient of reliability.

As a result of the interrogatory the expert system displays the conclusion and the chain of reasoning on the screen to check the validity of the given conclusion.

The expert system permits:

- to store in the data base the information about the expert system conclusions concerning every examined patient;
- to store in the data base the patients examination results at a facility (or a certain territory), the results are grouped according to the conclusions made by the expert system.

Conceptually the work of the expert system prototype realized with the help of the described programme product, may be presented as follows: at the initial stage there is a hypothesis (fact-target), which is to be proved or refuted. On the basis of the

knowledge base, represented by a set of rules, the facts received from a user, are analysed. As a result "the dioxin exposure" is diagnosed with a larger or smaller coefficient of reliability. The initial coefficient of reliability is defined in accordance with the first analysed rule and is being corrected while passing from one rule to another according to the following formula:

$$C_{\text{reliability}} = ((100 * C_1) + (100 * C_2) - (C_1 * C_2)) / 100$$

where C_1, C_2 - the coefficients of reliability of the two subsequent rules.

The system uses only those rules that ensure the shortest route for obtaining the reliable result on the basis of an optimal number of facts received from a user. Such an approach makes it unnecessary to carry out the numerous surveys of the knowledge data and only indispensable questions are asked.

The merits of the expert system "DIOXIN" are:

- high productivity (1-3 min per a patient);
- absence of false-negative functioning;
- storage of information for every patient for the subsequent statistic processing;
- output to a printer for the lists of patients interrogated or those, who are to be subjected to a profound medical examination (on a physician request).

The expert system "DIOXIN" is supposed to work together with IBM-compatible personal computers.

The suggested expert system is considered to be a base model suitable for the operative formation of expert systems for other harmful agents on it's base.

