

VETERINARY TOXICOLOGY INFORMATION SYSTEM

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Abstract: A Veterinary Toxicology Information System project has been started in Poland due to the country's growing needs in the field of veterinary toxicological remote consultations. An application designed to be accessed by veterinary surgeons will help them in poisoning diagnoses. Various data mining, classification and statistical/analytical methods will be available in the system for toxicology researchers.

Keywords: toxicology, data base, veterinary medicine

1. Introduction

Reports from Toxicology Information Centers in London, Lyon and Urbana-Champaign, Illinois, have shown a significant increase of recorded animal poisonings and veterinary toxicological consultations [1]. Despite its needs in this field, Poland still lacks a veterinary toxicological information center that could register data and disseminate information on animal poisonings.

The gathered toxicological information concerning animal poisonings could be used in the field of population threat assessment and evaluation of environmental hazards. The need for the creation of a toxicological information center in Poland has led to the launching of the Veterinary Toxicology Information System project by the Pharmacology and Toxicology Department of the Warsaw Agriculture University (SGGW). The prospective users of this system are toxicology researchers and veterinary surgeons. Veterinary Hygiene Laboratories and Environmental Protection Inspectorates will also have access to this system.

The aims of the system are based on the described users' needs. A data structure for veterinary toxicology has been build, granting toxicology researchers access to record knowledge from their field. Processing the data will offer researchers possibilities to mine the animal poisonings data [2, 3], to statistically examine toxicants,

poisoning occurrences and treatments [4] and analytically research epidemiological animal populations.

Within the system, an application supporting poisoning diagnoses will be available for veterinary surgeons. The main function of the application will be identifying the most probable causes of poisoning, including numerous toxicants. In this module, a veterinary surgeon will also record information about his poisoning case and the undertaken therapeutic process.

2. Information flow

The scope of information contained in the system can be divided into two areas. One area covers toxicological knowledge needed for the system's creation and toxicological expert and bibliography data for the input of the database. This area is intended to be accessed by veterinary surgeons. The other area of the system encompasses poisoning cases from a veterinary surgeon's practice. Here, the recorded information is sent via a computer network to a server, where it will be the object of toxicologists' scrutiny. Information feedback is created concerning the two data collections (see Figure 1).

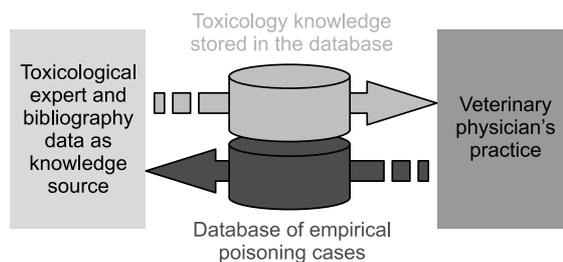


Figure 1. Information feedback in the system

Data transfer is intended to have a client-server structure in compliance with medical information exchange standards [3]. The data track encompasses a database server capable of data mining, a web pages server, server-side scripts and client-side scripts. This configuration guarantees full functionality to a veterinary surgeon and no client-side data upgrade will be needed. The empirical data of poisoning records from the surgeon will be returned to the server.

3. Research on information within the system

In the project, a structure was created and research on the information content of the system was carried out. Data structure was a critical issue, the more complicated poisoning symptoms depend not only on the toxicant's features, but also on the animal's specie and breed, on the time since exposition and on many animal characteristics from the moment of exposition [5, 6].

Effective data processing in the field of animal poisonings depends on certain information conditions: unification of notions, an exhaustive list of poisoning symptoms and sufficiently thorough representation of poisoning in the symptom sets.

Research on toxic substances includes toxicant selection and determination of properties for the system's purposes. Symptom classification includes single typical

symptom selection and classification. Thanks to the listed research, several prototypes of data structure and user interface were created within the project.

Information on poisonings and poisoning symptoms defines a field of data analysis for animal poisoning diagnosis. The most important information research tasks can be defined as follows:

- knowledgeable construction of a symptom space with dimensions of single typical symptoms [5, 6],
- selection of suitable similarity and distance measures, allowing generation of the most similar poisoning profile hypothesis and distance in the symptom space [7], and
- further analysis of data mining possibilities within the created database [2, 3].

There are some factors which affect the construction of symptom space information narrowing its information capacity (see Figure 2). The most important one is a subset of typical symptoms from all the known poisoning symptoms. This restriction should not omit substantial poisoning information, needed in the following data processing and knowledge data mining.

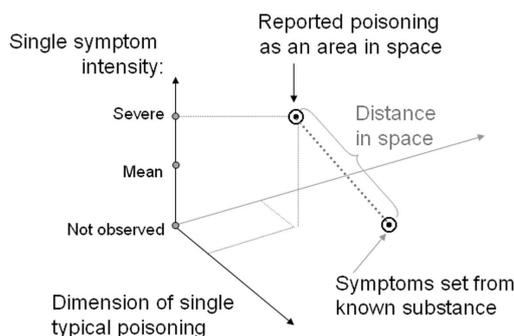


Figure 2. Symptom space and distance between single symptom sets

Further restrictions are defined by the method of recording animal poisonings. On the basis of a research of veterinary surgeons' task completions, methods of practically supporting this work have been identified. One of these is providing the surgeon, as the user, with an adequate tool supporting the computer record of an animal poisoning case. Here, the most important issues are the ease of symptom finding, uniqueness of single symptoms and symptoms' exhaustiveness of the poisoning. It has been achieved by symptom classification and symptom intensity definition. This needs further classification research for the sake of the registration process and identification of laboratory test results' measurement scales.

In order not to overload the veterinary surgeon in the discrimination process, a simplification of measurement scales will be applied, using nominal or interval scales with few points in substitution of a ratio scale with continuous values. This can substantially decrease the amount of information acquired on a poisoning case [7].

Expert knowledge, bibliographical data and empirical records will form the basis of analytical research on the gathered data. The Veterinary Toxicology Information System is intended to contain analytical procedures in the following areas:

- A. Research based on measure of similarity in the symptom space [4] using case-based reasoning [8] and the following data mining techniques [3]:
1. Poisoning case diagnostic process support – selecting in the space of typical symptoms the poisoning case most similar to the query of the current case:
 - identification of the most probable poisoning cause (toxic substance hypothesis),
 - laboratory test indications for case verification, and
 - a proposal of a therapeutic procedure for the found toxicants.
 2. Identification of similar symptom clusters in the symptom space:
 - assignment of the most misidentified substances to the certain toxicant,
 - verification of a diagnosis by comparing differential symptoms from the space neighborhood,
 - verification of the existing indications of differential symptoms, and
 - identification of differential symptom sets – defining sets of symptoms for similar poisoning profiles can be contrasted. This can expand the notion of a differential symptom.
 3. Cluster identification in the symptom space:
 - experimenting in cluster naming and poisoning classification based on clusters [4],
 - comparison of the obtained classification with the already known ones, and
 - detailing the reasoning possibilities of diagnosis support and a proposal of therapeutic procedures based on inclusion into clusters of poisonings.
- B. Exploration of data classification methods [7]:
1. Poisoning hypothesis generation using a symptom decision tree.
 2. Extension of the differential symptom notion employing symptom values, qualifying a poisoning to a certain group.
 3. Identification of a veterinary surgeon's practical rules during poisoning diagnosis. Recognition of substances more difficult for the surgeon to diagnose.
- C. Statistical research [4]:
1. Statistical reasoning on the gathered bibliography and expert data.
 2. Poisoning statistics, poisoning risk assessment analysis.
- D. Verification of expert knowledge based on an analysis of empirical data:
1. Changing metrics in the poisoning symptom space.
 2. Upgrading data in the poisonings database.
 3. Research verifying the current toxicological knowledge.

Most of the analytical research is currently at an initial stage. The main aim of this phase of the project is animal poisoning diagnosis support, where the important issues are the symptom space and an investigation of similarity measures.

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