

Glossary of Acronyms and Terms

Glossary of Acronyms

AAALAC	—American Association for Accreditation of Laboratory Animal Care	CIOMS	--Council of International Organizations of Medical Sciences
AALAS	—American Association for Laboratory Animal Science	CITES	--Convention on International Trade in Endangered Species
AAMC	—Association of American Medical Colleges	CPSC	—U.S. Consumer Product Safety Commission
AAVMC	—Association of American Veterinary Medical Colleges	CTFA	—Cosmetic, Toiletry, and Fragrance Association
ACC	—Animal Care Committee (Canada)	CT&T	— <i>Chemical Times and Trends</i>
ACP	—American College of Physicians	DHEW	—U.S. Department of Health, Education, and Welfare (see DHHS)
ACUC	—Animal Care and Use Committee	DHHS	—U.S. Department of Health and Human Services
ADAMHA	—Alcohol, Drug Abuse, and Mental Health Administration (PHS, DHHS)	DOD	—U.S. Department of Defense
AFAAR	—American Fund for Alternatives to Animal Research	DOE	—U.S. Department of Energy
ALD	—Approximate Lethal Dose	DOT	—U.S. Department of Transportation
ALDF	—Animal Legal Defense Fund	EPA	—U.S. Environmental Protection Agency
AMD	—Aerospace Medical Division (U.S. Air Force)	EWST	—Ethics and Values in Science and Technology (NSF program)
APA	—American Psychological Association	FAA	—U.S. Federal Aviation Administration
APHIS	—Animal and Plant Health Inspection Service (USDA)	FASEB	—Federation of American Societies for Experimental Biology
APS	—American Physiological Society	FDA	—Food and Drug Administration (PHS, DHHS)
ARC	—Animal Research Committee	FIFRA	—Federal Insecticide, Fungicide, and Rodenticide Act
ASPCA	—American Society for the Prevention of Cruelty to Animals	FOA	—Friends of Animals, Inc.
AUCC	—Association of Universities and Colleges of Canada	FOIA	—Freedom of Information Act
AVMA	—American Veterinary Medical Association	FR	—Federal Register
BID	—bureau, institute, or division (NIH)	FRAME	—Fund for Replacement of Animals in Medical Experiments
BIOSIS	—Biosciences Information Service	FTC	—U.S. Federal Trade Commission
CAAT	—Center for Alternatives to Animal Testing (The Johns Hopkins University)	GAO	—General Accounting Office (U.S. Congress)
CALAS	—Canadian Association for Laboratory Animal Science	GLP	—Good Laboratory Practices
CBO	—Congressional Budget Office (U.S. Congress)	IACUC	—Institutional Animal Care and Use Committee
CCAC	—Canadian Council on Animal Care	ILAR	—Institute for Laboratory Animal Resources (NRC)
CDC	—Centers for Disease Control (PHS, DHHS)	IRAC	—Interagency Research Animal Committee
CERCLA	—Comprehensive Environment Response, Compensation, and Liability Act	IRB	—Institutional Review Board
CFHS	—Canadian Federation of Humane Societies	ISEF	—International Science and Engineering Fair
CFR	—Code of Federal Regulations	LADB	—Laboratory Animal Data Bank
CIIT	—Chemical Industry Institute of Toxicology	LC ₅₀	—median lethal concentration
		LD ₅₀	—median lethal dose
		LSRO	—Life Sciences Research Office (FASEB)
		MRI	—magnetic resonance imaging
		NAL	—National Agricultural Library

NAS	—National Academy of Sciences	SBIR	—Small Business Innovation Research (program)
NASA	—National Aeronautics and Space Administration	SPCA	—Society for the Prevention of Cruelty to Animals
NBS	—National Bureau of Standards (Department of Commerce)	SSR	—Society for the Study of Reproduction
NCI	—National Cancer Institute (NIH)	TDB	—Toxicology Data Bank (NLM)
NCTR	—National Center for Toxicological Research (FDA)	TSCA	—Toxic Substances Control Act
NIDA	—National Institute on Drug Abuse (ADAMHA)	UNEP	—United Nations Environment Program
NIEHS	—National Institute of Environmental Health Sciences (NIH)	UNESCO	—United Nations Educational, Scientific, and Cultural Organization
NIH	—National Institutes of Health (PHS, DHHS)	USDA	—U.S. Department of Agriculture
NIHARC	—National Institutes of Health Animal Research Committee	VA	—U.S. Veterans' Administration
NIMH	—National Institute of Mental Health (ADAMHA)	WHO	—World Health Organization
NIOSH	—National Institute for Occupational Safety and Health (CDC)	WRPRC	—Wisconsin Regional Primate Research Center
NLM	—National Library of Medicine (NIH)		
NRC	—National Research Council		
NSF	—National Science Foundation		
NTIS	—National Technical Information Service (Department of Commerce)		
NTP	—National Toxicology Program (NIEHS)		
NWHL	—National Wildlife Health Laboratory		
OECD	—Organization for Economic Cooperation and Development		
OSHER	—Office of Health and Environmental Research (DOE)		
ONR	—Office of Naval Research (Navy)		
OPRR	—Office for Protection from Research Risks (NIH)		
OSHA	—Occupational Safety and Health Administration (U.S. Department of Labor)		
OSTP	—Office of Science and Technology Policy (Executive Office of the President)		
OTA	—Office of Technology Assessment (U.S. Congress)		
OTS	—Office of Toxic Substances (EPA)		
PHS	—U.S. Public Health Service (DHHS)		
PMA	—Pharmaceutical Manufacturers' Association		
PRI	—Primate Research Institute (University of New Mexico)		
QSAR	—quantitative structure-activity relationships		
RCRA	—Resource Conservation and Recovery Act		
R&D	—research and development		
RRF	—Registered Research Facility		
RTECS	—Registry of Toxic Effects of Chemical Substances (NIOSH)		

Glossary of Terms

Acute Toxicity Test: Tests that are used to detect the toxic effects of single or multiple exposures to a substance occurring within 24 hours. These are frequently the first tests performed to determine the toxic characteristics of a given substance. One of the most common acute toxicity tests is the LD₅₀ test.

Alternatives to Animal Use: For purposes of this assessment, OTA has chosen to define "alternatives" as encompassing any subjects, protocols, or technologies that replace the use of laboratory animals altogether; reduce the number of animals required; or refine existing procedures or techniques so as to minimize the level of stress endured by the animal. These technologies involve the continued, but modified, use of animals; use of living systems; use of chemical and physical systems; and use of computers.

American Association for Accreditation of Laboratory Animal Care (AAALAC): A voluntary private organization that, by April 1985, provided accreditation for 483 institutions. AAALAC accreditation is based on the provisions of the NIH *Guide for the Care and Use of Laboratory Animals*, and is recognized by the PHS.

Ames Test: The most commonly used test for mutagenicity, it tests "reverse mutation" by exposing an already mutated strain of micro-organism to potential mutagens. If the mutation is reversed the micro-organisms regain their ability to produce the amino acid histidine and will proliferate in a histidine-deficient culture medium. However, when used alone the Ames test does not seem to be as predictive of human carcinogenicity as are animal tests.

Analgesic: An agent that relieves pain without causing loss of consciousness.

Anesthetic: An agent that causes loss of the sensation of pain, usually without loss of consciousness. Anesthetics may be classified as topical, local, or general.

Animal: For purposes of this assessment, animal is defined as any nonhuman member of five classes of vertebrates: mammals, birds, reptiles, amphibians, and fish. Within this group, two kinds of animals can be distinguished, warm-blooded animals (mammals and birds) and cold-blooded animals (reptiles, amphibians, and fish). Under this definition, invertebrates are not considered to be animals.

Animal Care and Use Committee (ACUC): An institutional committee that oversees housing and routine care of animals. The committee may also review research proposals. The committee's membership generally includes the institution's attending veterinarian, a representative of the institution's administration, users of research animals, and one or more nonscientist and lay members.

Animal and Plant Health Inspection Service (APHIS): A branch of USDA that, among other duties, is charged with the enforcement of the Animal Welfare Act. Enforcement of the act is directed through four regional offices and is carried out by 286 APHIS Veterinary Medical Officers (inspectors) who spend about 6 percent of their time inspecting over 1,200 research facilities (many of which have multiple sites).

Animal Use The use of animals for research purposes. Three aspects of animal use are dealt with in this assessment: in behavioral and biomedical research; in testing products for toxicity; and in the education of students at all levels. This assessment does not cover animal use for food and fiber; animal use to obtain biological products; or animal use for sport, entertainment, or companionship.

Animal Welfare Act: This act, passed in 1966 and amended in 1970, 1976, and 1985, was originally an endeavor to stop traffic in stolen animals that were being shipped across State lines and sold to research laboratories. Amendments to the act have expanded its scope to include housing, feeding, transportation, and other aspects of animal care. However, the act bars regulation of the conduct of research and testing by USDA. Animals covered by the act, as currently enforced, are dogs, cats, hamsters, rabbits, guinea pigs, nonhuman primates, and marine mammals. The Animal Welfare Act is enforced by APHIS.

Animal Welfare Enforcement Report: Annual report submitted to Congress by APHIS, based on data collected from the Annual Report of Research Facility forms.

Animal Welfare Groups: There are a number of groups concerned with animal rights and animal welfare—e. g., the ASPCA, FOA, and AFAAR. These groups cover a broad spectrum of ethical concerns about animal use, they may question the objectives as well as the means of research, but they generally

find common ground in the principle of humane treatment of animals.

Annual Report of Research Facility: This is required under the regulations stemming from the Animal Welfare Act. Research facilities must submit these annual reports, detailing animal use, to APHIS for evaluation. (Elementary and secondary schools are exempt, as are facilities using exempt species.) APHIS presents data collected from these reports to Congress in its annual *Animal Welfare Enforcement Report*.

Anticruelty Statutes: Laws passed by States that prohibit active cruelty, and in some cases passive cruelty (neglect), to animals. Some of these laws acknowledge the potential application of anticruelty statutes to research animals, but most of them exempt "scientific experiments" entirely. Twenty States and the District of Columbia regulate research to some extent. Twenty-one States have some provisions in their codes requiring the teaching of "kindness" to or the "value" of animals, and a few place restrictions on animal experimentation in secondary schools.

Behavioral Research: Research into the movements and sensations by which living things interact with their environment, with the purpose of better understanding human behavior. A further goal of behavioral research is the better understanding of animal species of economic or intrinsic interest to humans. Behavioral research differs from biomedical research in that it is difficult to study behavioral phenomena in isolation; therefore continued, but modified, use of animals holds most promise for this area of research.

Biological Model A surrogate or substitute for a process or organ of interest to an investigator. Animals or alternatives can serve as biological models.

Biological Testing: The repetitive use of a standard biological test situation or protocol employing different chemicals or different test parameters. Such test protocols are more stereotyped than those used in research, and may be more amenable to the institution of a computerized data retrieval system.

Biomedical Research: A branch of research devoted to the understanding of life processes and the application of this knowledge to serve humans. A major user of animals, biomedical research affects human health and the health care industry. It is instrumental in the development of medical products such as drugs and medical devices, and in the development of services such as surgical and diagnostic techniques. Biomedical research covers a broad spectrum of disciplines, such as anatomy, biochemistry, biology, endocrinology, genetics, immunology, nutrition, oncology, and toxicology.

Carcinogen: An agent or process that significantly in-

creases the incidence of abnormal, invasive, or uncontrolled cell growth in a population. Carcinogens fall into three classes: chemicals, viruses, and ionizing radiation. A variety of screening assays have been developed to detect chemical carcinogens, including the Salmonella-mediated mutagenesis assay (Ames test), the sister chromatid exchange assay, and traditional laboratory animal toxicity tests.

Cell Culture: Growth in the laboratory of cells isolated from multicellular organisms. Each culture is usually of one type. Cell culture may provide a promising alternative to animal experimentation, for example in the testing of mutagenicity, and may also become a useful adjunct in repeated dose toxicity testing.

Center for Alternatives to Animal Testing (CAAT): Established by the Johns Hopkins University in 1981 to search for alternatives to animal use, CAAT puts out publications and supports intramural and extramural research. The Center is sponsored by the CTFA and corporate donors as well as consumer and industrial groups.

Chick Embryo Chorioallantoic Membrane Assay: A test used to determine the irritancy of a substance. A test sample is placed on the chorioallantoic membrane formed on top of a chick embryo. The membrane is then evaluated for response to the test substance and the embryo is discarded. This test may be a promising alternative to the Draize Test.

Chronic Toxicity Test: Repeated dose toxicity test with exposure to a test substance lasting at least 1 year, or the lifetime of the test species.

Comprehensive Environment Response, Compensation, and Liability Act (CERCLA): Known as "Superfund," CERCLA authorizes the Federal Government to cleanup or otherwise respond to the release of hazardous wastes or other pollutants that endanger public welfare.

Crossover Test: A useful laboratory or clinical method whereby an animal serves as its own control by first receiving a drug or a placebo and then receiving the reverse. This kind of test has potential applications in anesthesiology, endocrinology, radiology, and various other fields.

Computer Simulation: The use of specially devised computer programs to simulate cells, tissues, fluids, organs, and organ systems for research purposes; to develop mathematical models and algorithms for use in toxicity testing; and to simulate experiments traditionally done with animals, for educational purposes.

Data Sources: Can provide an alternative to animal testing by disseminating information generated from prior use of animals. The TDB and RTECS are two such sources, as was the LADB.

Descriptive Toxicology A branch of toxicology dealing with phenomena above the molecular level. Descriptive toxicology relies heavily on the techniques of pathology, statistics, and pharmacology to demonstrate the relationship between cause and effect—e.g., that certain substances cause liver cancer in certain species within a certain time. It is most often used in regulatory schemes requiring testing.

Distress: Usually the product of pain, anxiety, or fear. However, distress can also occur in the absence of pain. For example, an animal struggling in a restraint device may be free from pain, but maybe in distress. Distress can be eased with tranquilizers.

Draize Eye Irritancy Test: A test that involves placing a single dose of a test substance into one eye of four to six rabbits (the other eye remains untreated) and observing its irritating effects. A promising alternative to this test is the chick embryo chorioallantoic membrane assay.

Education: The aspect of education dealt within this assessment is the use of animals and alternatives in the teaching of life sciences to secondary school students, university students, health professionals and preprofessionals, and research scientists.

Federal Environmental Acts: A number of these have been passed to protect human health and the environment from the adverse effects of toxic substances, and to regulate the release of such substances into the environment. Among these acts are FIFRA, TSCA, the Clean Air Act, the Clean Water Act, RCRA, CERCLA, and the Consumer Product Safety Act, Animal testing provides much of the data needed for the enforcement of these acts.

Federal Government Use of Animals for Research Six Cabinet departments and four Federal agencies conduct intramural research and testing involving animals. They are: USDA, Department of Commerce, DHHS, DOD, Department of the Interior, DOT, CPSC, EPA, NASA, and the VA.

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA): Designed to protect the human environment from the adverse effects of pesticides and their use, FIFRA regulates various aspects of pesticide use by means of registration, labeling, and the setting of maximum residue levels. It also established procedures for safe application, storage, and disposal of pesticides.

Good Laboratory Practices (GLP): Rules adopted by FDA in 1978 requiring that all regulated parties conducting nonclinical laboratory studies keep records and permit audits of such studies. The GLP rules also contain specific provisions for animal housing, feeding, and care. In 1983, EPA issued similar GLP

rules for its toxic substances and pesticides research programs.

Guidelines for Animal Care and Use: Various organizations outside the Federal Government have adopted their own guidelines—e.g., the APA's *Guidelines for Ethical Conduct in the Care and Use of Animals*, which is the most comprehensive and has been endorsed by FASEB; the APS's *Guiding Principles in the Care and Use of Animals*; and the AVMA's *Animal Welfare Guiding Principles*. For Federal guidelines, see Interagency Research Animal Committee, NIH *Guide for the Care and Use of Laboratory Animals*, and PHS *Policy*.

Hepatotoxicity: The quality of exerting a destructive or poisonous effect upon the liver.

Homology The correspondence among organisms of structures and functions derived from a common evolutionary origin (e.g., a common gene structure).

Immunoscintigraphy The use of external radioimaging techniques to locate tumors and to identify certain noncancerous diseases.

Institute for Laboratory Animal Resources (ILAR): A component of the National Research Council, ILAR performs periodic surveys on the use of laboratory animals.

Interagency Research Animal Committee (IRAC): This committee was formed by 14 Federal entities in recognition of a need for an interagency body knowledgeable about the welfare of research animals. IRAC meets regularly to discuss research needs and has written *principles for the Utilization and Care of Vertebrate Animals Used in Testing, Research and Training*. These *Principles*, which incorporate nine injunctions on animal welfare, are intended to serve as a model for Federal agencies in developing policies on animal use.

Invertebrate Any nonplant organism without a spinal column—e.g., worms, insects, and crustaceans. Invertebrates account for 90 percent of the Earth's nonplant species. For the purposes of this assessment, invertebrates are not considered to be animals.

In vitro: Literally, in glass; pertaining to a biological process or reaction taking place in an artificial environment, usually a laboratory. Human and animal cells, tissues, and organs can be cultured in vitro. In vitro testing may hold some promising alternatives to animal testing—e.g., in testing for eye irritation and mutagenicity.

In vivo: Literally, in the living; pertaining to a biological process or reaction taking place in a living cell or organism.

Laboratory Animal Data Bank (LADB): Founded by NCI and NLM in the late 1970s, the LADB was sup-

posed to provide a computer-based registry of research and testing data. However, the data were limited and consequently LADB had few users. It was terminated in 1981 because of lack of funding. It exists today only as an archival reference,

LC₅₀: An acute toxicity test used to screen substances for their relative toxicity. LC₅₀ is calculated to be the lethal concentration for half of the animals exposed to a test substance. Exposure may be by breathing vapor or immersion in liquid (e.g., fish in water).

LD₅₀: An acute toxicity test used to screen substances for their relative toxicity. LD₅₀ is calculated to be the lethal dose for half of the animals exposed to a test substance. Exposure is often by ingestion.

Mechanistic Toxicology An approach to testing that focuses on the chemical processes by which a toxic effect occurs. Mechanistic toxicology testing relies heavily on physiology, biochemistry, and analytical chemistry techniques to monitor these processes.

Micro-organism: A minute microscopic or submicroscopic living organism, such as bacteria, viruses, and protozoa.

Mutagen: An agent that induces chemical changes in genetic material. Chemicals, viruses, and ionizing radiation can be mutagenic. Most carcinogens are mutagens, therefore many screening tests to detect carcinogens are designed to detect the mutagenic potential of the compound. Some mutagens are not direct-acting, requiring metabolic activation in the body before they exert their mutagenic potential.

National Toxicology Program (NTP): NTP was chartered in 1978 as a cooperative effort by DHHS. Participants in NTP are NIH (through its agencies NCI and NIEHS), FDA (through NCTR), and CDC (through NIOSH). The stated goals of NTP include the expansion of toxicological information; expansion of numbers of chemicals to be tested; the validation, development, and coordination of tests to meet regulatory needs; and the communication of programs, plans, and results to the public.

Neurotoxicity: The quality of exerting a destructive or poisonous effect on nerve tissue.

NIH Guide for the Care and Use of Laboratory Animals: Revised in 1985, the *Guide* lays out detailed standards for animal care, maintenance, and housing. Its provisions apply to all research supported by NIH, and it is used by most animal research facilities, both within and outside the Federal Government. AAALAC and PHS also use it when assessing research facilities for accreditation.

Nonliving Systems: Inanimate chemical or physical systems used in testing.

Oncology: The study of tumors.

Organ Culture: The attempt to isolate and maintain animal or human organs in in-vitro culture. Long-term culture of whole organs is not generally feasible, but they can be sustained in cultures for short periods (hours or days).

Pain: Discomfort resulting from injury or disease. Pain can also be psychosomatic, the product of emotional stress. Pain can be induced by mechanical, thermal, electrical, or chemical stimuli, and it can be relieved by analgesics or anesthetics.

Pharmacokinetic Studies: A branch of toxicity testing that provides information about the mechanics of absorption.

PHS Policy on Humane Care and Use of Laboratory Animals by Awardee Institutions: Revised in 1985, the Policy applies to PHS-supported activities involving animals (including those of NIH). It relies on the NIH *Guide for the Care and Use of Laboratory Animals*, and uses institutional committees for the assessment of programs and maintenance of records.

Pound Release Laws: State laws that provide for the seizure, holding, and humane disposal of stray and unwanted animals. Most States permit the release of unowned animals to research institutions that have met specified conditions. These laws have been closely scrutinized. In the past 10 years and nine States have passed laws prohibiting the release of stray animals to research institutions. The most far-reaching of these laws takes effect in Massachusetts in 1986. Also referred to as "pound seizure laws."

Protocol: The plan of a scientific experiment or treatment.

Reduction Considered an alternative to animals when fewer animals are used in research and education through changed practices, sharing of animals, or better design of experimental protocols.

Refinement: An alternative to animal use by better use and modification of existing procedures so that animals are subject to less pain and distress. Examples of such refinements are the administration of anesthetics and tranquilizers, humane destruction, and the use of noninvasive imaging techniques.

Registry of Toxic Effects of Chemical Substances (RTECS): An annually published compendium, extracted from the literature, of known toxic and biological effect of chemical substances. RTECS is published by NIOSH under the provisions of the Occupational Safety and Health Act of 1970.

Repeated-Dose Toxicity Test: Repeated or prolonged exposure to measure the cumulative effects of exposure to a test substance. These tests involve chronic, subchronic, or short-term exposure to a test substance.

Replacement: An alternative to animal use, replacing methods using animals with those that do not. Examples include the use of a placenta instead of a whole animal for microsurgical training, the use of cell cultures instead of mice and rats, the use of non-living systems, and the use of computer programs.

Research: The development of new knowledge and technologies, often with unpredictable but potentially significant results. Uncertainty, missteps, and serendipity are inherent in the research process. Research is distinguished from testing by the ways in which animals are used, and the identity of the investigators. There are more research procedures than there are tests, and researchers are more likely to develop their own procedures.

Research Facility Under the Animal Welfare Act, any individual, institution, organization, or postsecondary school that uses or intends to use live animals in research, tests, or experiments. Facilities that receive no Federal support for experimental work and that either purchase animals only within their own State or that maintain their own breeding colonies are not considered research facilities under the act, however.

Resource Conservation and Recovery Act (RCRA): This act was passed to protect public health and the environment through the regulation of the management and handling of hazardous waste and through the control of solid waste disposal.

Resusci-Dog: A plastic mannequin linked to a computer. The Resusci-Dog can simulate an arterial pulse and pressure can be applied to its ribcage for cardiac massage or cardiopulmonary resuscitation.

Sequential Design Test: The comparison of treatment groups at set stages of experimentation. Further experimentation at higher doses is undertaken only if there is no significant difference between the two groups. This kind of test has potential application in anesthesiology, endocrinology, nutrition, and other fields.

Serial Sacrifice: The sequential killing of animals to examine the occurrence and progress of induced effects.

Short-Term Toxicity Test: Repeated dose toxicity test that involves exposure to a test substance over a period of 2 to 4 weeks.

Speciesism: A term used by some animal rights activists, referring to the denial of animal rights as a moral breach analogous to racism or sexism.

State Environmental Acts: Legislation passed by States to regulate pesticides, air quality, water, and waste products. These laws are often the simple adoption or recodification of existing Federal laws.

Subchronic Toxicity Test: Repeated dose toxicity test

of intermediate duration, with exposure to a test substance for 3 to 6 months.

Testing: Standardized procedures that have been demonstrated to predict certain health effects in humans and animals. Testing involves the frequent repetition of well-defined procedures with measurement of standardized biological endpoints. A given test may be used to test many different substances and may use many animals. Testing is used to establish the efficacy, safety, and toxicity of substances and procedures.

Tissue Culture: The maintenance in vitro of isolated pieces of a living organism. The various cell types are still arranged as they were in the original organism and their differential functions are intact.

Toxic Substances Control Act (TSCA): This act authorizes EPA to regulate substances that present an unreasonable risk of injury to health or to the environment. The act also requires the reporting or development of data to assess the risks posed by a given substance.

Toxicity Testing: The testing of substances for toxicity in order to establish conditions for their safe use. There are now more than 50,000 chemicals on the market and 500 to 1,000 new ones are introduced

each year. The Federal agencies with the largest role in toxicity testing are FDA, EPA, CPSC, and OSHA.

Toxicology Data Bank (TDB): Made public by the NLM in 1978, the TDB provides toxicity information on more than 4,000 chemicals and substances. TDB information is based on conventional published sources.

Tranquilizer: An agent that quiets, calms, and reduces anxiety and tension, with some alteration of the level of consciousness.

T-test: An estimate of the difference between the mean values of one parameter of two treatments. This can be a powerful measure when the number of comparisons is small, but the potential for error increases as the number of parameters grows.

Veterinary Medicine: The maintenance and improvement of the health and well-being of animals, particularly the 30 to 40 different species of animals of 'economic, ecological, and environmental importance. Veterinary medicine is closely allied with veterinary research.

Veterinary Research: A branch of biomedical research devoted to the understanding of the life processes of animals and the application of this knowledge to serve animals as well as humans.