

## ALTERNATIVES TO ANIMAL EXPERIMENTATION IN TEACHING PHARMACOLOGY: COMPUTER ASSISTED LEARNING TECHNIQUES IN PHARMACY CURRICULUM

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### ABSTRACT

*Computer assisted (CAL) techniques as an alternative to animal experiment is having a greater advantage due to increasing difficulty to perform animal experiments, because of issues related to the procurement of animals, strict regulations and ethical issues. Previously, the practical classes in pharmacology for undergraduate pharmacy course in India included more than 15 animal experiments with frog, mouse, rat, guinea pig, and rabbit and were mandatory for the students to carry out animal experiments to pass the exam. At present in 2014 with the notifications by Pharmacy council of India (PCI) and University Grants Commission (UGC) the animal experiments have been replaced by alternatives with CAL techniques. Typically these techniques can fulfill the learning objectives of B. Pharmacy and Pharm D students to a greater extent and must be implemented with practice in institutes to overcome the barriers.*

**Key words:** CAL Techniques, Alternatives, Experimental Pharmacology, Indian Pharmacy Colleges

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### INTRODUCTION

Computer assisted learning (CAL) techniques are human education aids and teaching approaches that can replace harmful animal use and typically used to meet the existing teaching objectives and to provide outcomes that cannot be met through animal experiments. The Pharmacy Council of India (PCI) prescribes the theory and practical curriculum for all pharmacy subjects in undergraduate pharmacy course in various universities in India. Pharmacology is branch of science that deals with the study of drugs, is taught for 24 months in B.Pharmacy during third and fourth year and is also taught for Pharm D course in second and third year. Previously animal experiments are taught to students in practical class and they have to perform these animal experiments to get hands on experience. Students are also evaluated in practical examination at the end of the year and those who fail to clear examination are not promoted. Currently, all the animal experiments in pharmacology subject for B.Pharm and Pharm D are need to be replaced by CAL techniques as per the

regulatory bodies such as Pharmacy Council of India (PCI) and University Grants Commission, New Delhi.[1, 2]

### BACKGROUND

In 2008, the practical curriculum prescribed by PCI, India for Pharm.D in Pharmacology subject includes more than 10 experiment and in 1970s, for D.Pharm and B.Pharm includes more than 20 experiments were taught to pharmacy students using smaller animals such as frog, mouse, rat, rabbit and guinea pig and larger animal such as dogs were used for M.Pharm students having specialization in Pharmacology. However experiments with dog (effect of drugs on dog blood pressure and heart rate) and frog (ciliary motility with frog esophagus, bioassay with frogs rectus abdominis muscle) were restricted in pharmacy colleges. Some common laboratory techniques such as blood withdrawal, plasma and serum separation, procedures for rendering animal unconscious and chemical euthanasia were also include in the curriculum.[3,4]

**Table. 1: The list of experiments taught to pharmacy students in 1970s**

Name of the Species	Title of the experiment
Rabbit	Effect of autonomic drugs on rabbit eye Local anesthetic activity (Corneal method)
Guinea pig	Bioassay of histamine using guinea pig ileum Local anesthetic activity (Wheal method)
Rat	Anti-inflammatory activity Diuretic activity Spontaneous motor activity Stereotype activity Anti-catatonic activity Bioassay of drugs using isolated tissues (Colon, fundus, ileum, uterus, anococcygeus muscle) Estimation of pharmacokinetic parameters
Mouse	Effect of hepatic microsomal enzyme inhibitors and inducers on phenobarbitone sleeping time in mouse Analgesic activity (acetic acid writhing model, Eddys hot plate model and tail flick model) Anticonvulsant activity Skeletal muscle relaxant activity
Frog	Bioassay of drugs using rectus abdominis muscle Ciliary motility in frog esophagus Local anesthetic activity (Hind limb withdrawal reflex method)

The students were asked to perform the experiments in formative and summative examination and approximately 250 frogs, 100 rats, 10 guinea pig and 20 rabbits would be used every year for teaching a batch of 60 students.

### **Regulatory Framework and Animal Welfare:**

The framework in which alternatives to animal experiments can be developed – either standardized or formally validated – has to be seen in a global context. The global context is characterized by the need for mutual acceptance of experimental data, the limitation of global capacities of testing laboratories with an acceptable quality (e.g., good laboratory practice standards), and by the framework of global trade.[5,6]

The Central Government of India has constituted “The Committee for the Purpose of control and Supervision of Experiments on Animals”(CPCSEA) which was established under Chapter 4, Section 15(1) of the Prevention of Cruelty to animals Act 1960. The Committee is duty bound to take all such measures as may be necessary to ensure that animals are not subjected to unnecessary pains or suffering before, during or after the performance of the experiments of them. For this purpose, the Government has formulated “Breeding of

and Experiments on Animals (Control & Supervision) Rules, 1998” to regulate the experimentation on animals.[7,8]

In the exercise of powers conferred by Section 12(i) of the UGC Act, 1956, University Grants Commission, New Delhi in 1<sup>st</sup> August, 2014 (No. F.14-6/2014 (CPP-II)) issued instructions in the subject of dissection and animal experimentation in zoology/life sciences and allied disciplines in undergraduate, post graduate and research programmes. The objective is to prevent the disruption of bio-diversity and maintaining the ecological balance with the acquisition of appropriate alternative technology in place of animal experimentation and to develop competent skills. It is notified that all institutions of Higher Education shall constitute “Dissection Monitoring Committees” (DMC) to ensure strict compliance of instructions relating to the use of animals for research purposes only.[9] For undergraduate and postgraduate programs, both at major and allied levels, no animal from any species shall be dissected, either by teachers or students for any purposes. The teacher shall demonstrate one or more aspects to students with the help of digital alternatives and computer assisted learning etc.[8]

## **ALTERNATIVES TO ANIMAL EXPERIMENTATION**

Animal experiments are conventionally performed in undergraduate pharmacology teaching in India, to give the students an understanding of the mechanisms of action of drugs. However, it has become increasingly difficult to do animal experiments, because of issues related to the procurement of animals, their cost, and regulations controlling their use, and changes in ethical attitudes toward animal experimentation in general. It is also increasingly being felt that pharmacology teaching should be more clinically oriented. Also, there is growing opinion that animal experimentation should not be done just for the purpose of demonstration and imparting psychomotor skills to undergraduate students. Alternative suggestions include the experiments with tissues and body fluids of normal animals and humans, use of micro-organisms, primary cell culture and cell lines. Demonstrations of experimental procedures, videos and computer simulation models may be extensively being used in teaching undergraduate students in pharmacy education. Today, computer assisted learning has become a vital part in pharmacology curriculum and recent trend in the developments of information technology support the computer assisted simulation techniques.[10,11]

## **SIGNIFICANCE OF CAL TECHNIQUES**

CAL techniques are almost similar to the experiential method of education. Demonstration of the effect of drugs on various models like tissues or on whole animal is an integral and essential part of practical pharmacology teaching for pharmacy students. CAL and laboratory classes techniques are valuable tools for pharmacological experiments. Further, it is quite time consuming to demonstrate minute details of pharmacological procedures and drug effects to a batch of students and the increasing strength of practical batches is making it difficult to interact with each student. Hence CD containing CAL software for teaching animal experiments is becoming a revolution in pharmacological teaching.

CAL deals with a range of computer-based packages, which are focused on to provide interactive discussions usually in a specific subject area. These can range from sophisticated and expensive commercial packages to applications developed by projects in other educational institutions.[12] It has got unique presentational benefits, helps in personalized learning, and helps in achieving the ultimate goal of higher education. Various types of software such as Expharmpro, Excology, Exphysiology and Experimental Physiology have been developed for use in pharmacology and physiology courses. These include: simple drill (question and answer) software, video material, and tutorial and examination mode programs with offline version and examination mode with online version. The significance of these software package includes to demonstrate the effect of drugs by different species like frog, rat, mouse, guinea pig, rabbit and dog and also demonstrates the different laboratory techniques of euthanasia, anesthesia and routes of administration.

A few list of experiment with CAL for pharmacology curriculum for pharmacy students is listed below

- Effects of drugs on rabbit eye
- Effects of drugs on isolated frog heart
- Effects of drugs on ciliary motility of frog oesophagus
- Effects of blood pressure and heart rate of dog
- Bioassay of Histamine using guinea pig ileum
- Dose response curve, interpolation and matching bioassay multiple point bioassay,  $PA_{50}$  and  $PD_{50}$  value, agonistic and antagonistic assay with suitable isolated organs
- Analgesic activity, locomotor activity and skeletal muscle relaxant property
- Demonstration of routes of administration

## **DISCUSSION AND CONCLUSION**

The emerging trends of using CAL techniques as an alternative to animal experiments has a greater significance of

reduction of time, human source and repeatability. It prevents the unethical killing of animals and may promote the principles of Three (3 Rs) concepts, i.e., Replacement, Refinement and Reduction. [13]

CAL techniques can fulfill the practical scope and objectives of pharmacology curriculum of B.Pharmacy and Pharm D students to an acceptable reasonable extent with the reference to understanding the mechanism of action of drugs. It may help and motivate pharmacy students to study the mode of action of drugs and develop analytical skills and to prepare them for rational use of medicines.

The wide acceptance of CAL techniques in India was definitely made possible by many factors, including the affordability of hardware and software, growing awareness and restrictions implemented by CPCSEA, UGC and DMC. Most of the Universities in our country implemented the above techniques as an alternatives to animal experimentation and has now become a integrated part of practical teaching of pharmacology curriculum for B.Pharmacy and Pharm D. Students and thereby can avoid unnecessary pain and sufferings to the animals and animal welfare.

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