## Non- animal Methods of Scientific Research

In science, there are always many ways to address a given question. Animal experimentation is generally less efficient and reliable than many nonanimal methods, which include:

### 1. Epidemiology (Human Population Studies)

Medical research has always sought to identify the underlying causes of human disease in order to develop effective preventive and therapeutic measures. In contrast to artificial animal model conditions that generally differ in causes and mechanisms from human conditions, human population studies have been very fruitful. For example, the identification of the major risk factors for coronary heart disease, such as smoking, elevated cholesterol and high blood pressure, which are so important for prevention techniques, derives from epidemiological studies. Similarly, population studies have shown that prolonged cigarette smoking from early adult life triples age-specific mortality rates, but cessation at the age of 50 reduces the danger by half, and cessation at the age of 30 eliminates the danger almost completely.

### 2. Studies on Patients

The main source of medical knowledge has always been the direct study of human disease by closely monitoring human patients. For example, cardiologist Dean Ornish has demonstrated that a low-fat vegetarian diet, regular exercise, smoking cessation and stress management can reverse heart disease. Similarly, Caldwell Esselstyn has shown that lowering cholesterol levels with plant-based diets and medicines as needed arrests and often reverses heart diseaseHenry Heimlich has relied exclusively on human clinical investigation to develop techniques and operations that have saved thousands of lives, including the Heimlich maneuver for choking and drowning victims, the Heimlich operation to replace the esophagus (throat tube), and the Heimlich chest drainage valve.

Modern non-invasive imaging devices such as CAT, MRI, PET and SPECT scans have revolutionized clinical investigation. These devices permit the ongoing evaluation of human disease in living human patients and have contributed greatly to medical knowledge.

### 3. Autopsies and Biopsies

The autopsy rate in the United States and Europe has been falling steadily, much to the dismay of clinical investigators who recognize the value of this traditional research tool. Autopsies have been crucial to our current understanding of many diseases, e.g. heart disease, appendicitis, diabetes and Alzheimer's disease. Although the usefulness of autopsies is generally limited to the disease's lethal stage, biopsies can provide information about other disease stages.

### 4. Post-Marketing Surveillance

Thanks to advances in computer techniques, it is now possible to keep detailed and

comprehensive records of drug side effects. A central database with such information, derived from post-marketing surveillance, enables rapid identification of dangerous drugs. Such a data system would also increase the likelihood that unexpected beneficial side effects of drugs would be recognized. Indeed, the anti-cancer properties of certain medications and the mood-elevating effect of others were all discovered through clinical observation of side effects.

## 5. Other Non-animal Methods

***In-vitro* cell and tissue cultures** have proven to be powerful investigative tools. The NCI has now switched to 60 *in vitro* human cancer cell lines, a more reliable and much less costly alternative. Similarly, *in vitro* tests using cells with human DNA can detect DNA damage much more readily than animal tests.[2]

New drugs can be tested in human tissues. This could have predicted the catastrophic reaction to the drug TGN1412 in the clinical trial in London in 2006.

Regarding vaccines, researchers discovered already in 1949 that vaccines made from human tissue cultures not only were more effective, safer and less expensive than vaccines produced from monkey tissue, but also completely eliminated the serious danger of contamination with animal viruses. Likewise, many animal tests for viral vaccine safety have been replaced by far more sensitive and reliable cell culture techniques.

**Microfluidic circuits** provide the nearest thing to a human body on a chip. They comprise tiny channels with cells from various human organs and are linked by a circulating blood substitute.

Using these circuits, new drugs can be tested on a "whole system", where they encounter human cells in the same order as they would encounter them in the human body. Sensors in the chip then feed back information for computer analysis.

**Computer** modeling is now so sophisticated that scientists can simulate *in silico* in minutes or hours experiments that would take months or years to perform in animals. Drugs can be rationally designed on computers and then tested on virtual organs or in virtual clinical trials. Research teams around the world are working on a "virtual human" which will predict human responses more accurately than would ever be possible with any animal model.

**Micro-dosing** is a tremendously exciting breakthrough in drug development based on the principle that the best model for man is man. Human micro-dosing relies on ultra-sensitive analytical techniques and permits the safe introduction of miniscule doses (amounting to only 1% of the normal full dose) of new drugs into subjects in order to evaluate drug activity in the human body. The technique has proven quite accurate, with the results from micro-dosing studies showing a 70% correspondence with those from full-dose studies. Micro-dosing should replace misleading, unreliable animal testing and become part of phase 0 preclinical trials for every drug.

Both the FDA and the European Agency for the Evaluation of Medicinal Products have endorsed the use of micro-dosing to accelerate and improve the safety of drug development.

Source: www.mrmcmed.org