

## The 3<sup>rd</sup> Pharmacological Revolution

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### Abstract

The third pharmacological revolution marks an important stage in the evolutionary process of drugs used by humans. In less than a century, pharmacokinetic parameters and pharmacodynamic aspects have undergone important changes, providing increasingly effective therapeutic responses and a better margin of safety regarding the use of these drugs. Nano-drugs, biosimilars and monoclonal antibodies represent this moment of change and play a relevant role in the technological leap of the pharmaceutical industry. I highlight this transition period as an important milestone in the knowledge of pharmacology, therapeutics and medical practice, represented by the highly complex technological challenges to come.

### Introduction

At the same time as Joseph Virchow postulated that therapeutics could be the subject of a study of science in the early twentieth century, medicines began to play a prominent role in solving health problems [1].

When Penicillin was discovered in 1928, even if accidentally, Sir Alexander Fleming, a noted British pharmacologist, had no idea, but at that instant the 1<sup>st</sup> Pharmacological Revolution was initiated [2,3]. In 1940, Howard Florey and Ernest Chain improved the experiments with the antibiotics, allowing their production in large scale [3]. By the middle of the 20th century there was an expansion of the pharmaceutical invention, with advances in the development of vitamins, sulfonamides, antibiotics, hormones (thyroxine, oxytocin, corticosteroids and others), psychotropic drugs, antihistamines and several new vaccines. Many drugs formed entirely new therapeutic classes. Childhood deaths were cut in half, while maternal deaths from childbirth infections declined by over 90%. Some diseases such as tuberculosis, diphtheria and pneumonia can be treated and cured for the first time in human history. This period became known as the "Golden Age of the Pharmaceutical Industry" [4].

This avalanche of new drugs has brought many benefits to humans, highlighting the cure or treatment of various diseases.

In addition, the increase of the life expectancy, with the consequent improvement of the quality of life of the people [5].

However, some negative aspects were observed: irrational drug use, adverse reactions and drug interactions [6]. These occurrences have forced pharmaceutical companies to revise their clinical research protocols. It was the beginning of the 2nd Pharmacological Revolution, at which time the drug became the center of attention, being seen exaggeratedly as the solution of all health problems.

At that time, synthetic drugs became the largest proportion of the pharmaceutical market and improved research methods, therapeutic efficacy increased and drugs became safer, reducing their toxicity.

The pharmaceutical industry is undergoing a period of expansion with important launches of new molecules, the result of research increasingly targeted and focused on diseases such as cancer, AIDS, multiple sclerosis, Alzheimer's, diabetes, Malaria, Tuberculosis, among others [7-9].

It is exactly at this moment of transition between the techniques of synthesis and production of new drugs, that the 3rd Pharmacological Revolution is initiated. I am referring to monoclonal antibodies, biosimilars and nano-drugs [10,11].

Nano-drugs and monoclonals are molecules with a high degree of efficiency. In the case of nano technology, the reduction of adverse effects is important and the precision of its effects is impressive [11]. Biosimilars reproduce the actions of synthetics, but with lower costs [12].

The question is whether these new technologies provide all the expected results, economically accessible and with maximum safety and efficacy. Within a few years, the pharmacological bases of the therapy will be modified and the pharmacodynamic and pharmacokinetic profile of the drugs will have undergone profound changes, which certainly will lead to profound improvements in the solution of health problems [13].

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