A medicinal product is any substance or composition presented as having curative or preventive properties with regard to human or animal diseases. By extension, a medicinal product includes any substance or composition that may be used in or administered to humans or animals for the purpose of establishing a medical diagnosis or restoring, correcting, or modifying their physiological functions by exerting a pharmacological, immunological, or metabolic action. [The entire medicinal product chain (research, production, quality control, wholesale distribution, dispensing to patients, pharmacovigilance) is the responsibility of qualified medicinal product specialists, pharmacists.]

Expanded Definition

The concept of a medicinal product is precisely defined in France by Article L5111-1 of the Public Health Code.

Different types of medicinal products can be distinguished according to their use, components, regulatory registration process, etc.:

- Generic medicinal product;
- biosimilar medicinal product;
- orphan medicinal product;
- biological medicinal product;
- herbal medicinal product;
- essential medicinal product;
- narcotic medicinal product.

Related Concepts

- Dosage: This is the usual dose of the medicinal product used. It depends on the illness, the patient's age, weight, and certain individual factors: renal function, hepatic function. It should, of course, never be modified without medical advice or, if necessary, consulting a pharmacist.

Pharmacokinetics: This refers to the rate at which the active ingredient of a drug is absorbed, distributed throughout the body, metabolized (transformed), and then eliminated from the body. It determines the method of administration: oral (by mouth), intravenous, or other, as well as the number of daily doses, their timing, and the daily dose. In short, pharmacokinetics is the study of how the body reacts to a drug.

- Pharmacodynamics: This refers to the mechanism of action of the active ingredient that produces the therapeutic effects. In short, pharmacodynamics is the study of how a drug interacts with the body.
- Indication: This is a disease or condition for which a drug is used.
- Contraindication: This is the situation(s) in which taking the drug may be dangerous. Therefore, the drug should not be administered. We distinguish between relative contraindications where in some cases the benefit-risk ratio of taking the molecule remains acceptable, and absolute contraindications where the drug must not be taken, regardless of the expected benefit.
- Not recommended combination: to be avoided, except after a benefit/risk assessment; close monitoring is necessary.
- Precaution for use: this is the most frequent case; combination is possible provided the recommendations are followed.
- To be taken into account: risk must be reported; the practitioner must assess the appropriateness of the combination; no specific action is required.
- Synergy: this refers to the interaction between two drugs with identical pharmaceutical activity. The intensity of the combined activity is greater than that which could be obtained with either drug administered alone.
- Potentiation: this occurs between two drugs with different pharmaceutical activities.
- Antagonism: this is an interaction between two drugs with identical or different pharmaceutical activities. The simultaneous administration of two drugs results in the partial or complete inhibition of the action of one of them.

Actions

A drug can have one or more actions, described as:

- Substitution action: consists of providing the body with a deficient nutrient or physiological element (for example: methadone or vitamin C).

• Action by direct or indirect reproduction of the effects of a natural substance: the drug reproduces or stimulates a cellular or organ function, or the transmission of a nerve impulse at the level of the CNS (central nervous system) or autonomic nervous system (for example: sympathomimetic or parasympathomimetic).
Action by direct or indirect antagonism of the effects of a natural substance: the drug exerts a partial or complete blockage of a cellular or organ function by binding to specific receptors (e.g., sympatholytic).

• Mechanical action (e.g., paraffin oil promoting digestive transit).

• Action on certain metabolic processes: action on cellular permeability or the reactivity of certain cells to their physiological or pathological stimulus (e.g., calcium channel blocker (modifying the permeability of calcium ions)).

Active substance and excipient

A drug is composed of two types of substances: one or more active substances (also called the active ingredient—it is often the active substance that is referred to in everyday language as a drug) and one or more excipients.
The active substance(s) consist of a quantity of active product (dose) with a demonstrated pharmacological effect and a clinically proven therapeutic benefit. It should be noted that not every pharmacologically active substance necessarily forms the basis of a drug, let alone a drug therapy.

Excipients are inert auxiliary substances used in the formulation of the pharmaceutical form or intended to facilitate absorption by the body. These excipients are most often pharmacologically inert substances. Excipients allow the formulation of the active substance(s), that is, the presentation of the active substance in a specific pharmaceutical form. The formulation also allows the presentation of the The drug is formulated in the most suitable form for the desired route of administration and, if necessary, to modulate the rate of release of the active substance into the body. Examples of excipients include water and sucrose, the two excipients in simple syrup; and, in dry forms, modified starch(es) and modified cellulose(s), which are disintegrating agents used in dry dosage forms (tablets, capsules, etc.) to accelerate their breakdown once they reach the stomach. The vast majority of excipients are chemically inert and pharmacologically inactive substances. However, they are not always free of pharmacological effects in some patients. Indeed, some excipients are known to cause side effects (e.g., allergic or intolerance reactions) in a minority of patients.
particularly sensitive individuals. These are referred to as excipients with known effects. For example, lactose in lactose-intolerant patients. The prescriber or pharmacist must take this into account when prescribing and dispensing the medication. This is especially important when substituting a generic version of a brand-name product. The generic product is not necessarily formulated with the same excipients as the original brand-name product. This is one reason why a patient may not tolerate the generic substitute.

Principle of Bioequivalence

The principle of bioequivalence describes the bioequivalence of two medications containing the same amount of active substance. Active substances are considered bioequivalent if, for the same group of individuals, their therapeutic effects are deemed biologically equivalent. Differences in the physical characteristics of the active substances (crystalline structure or polymorphism, crystal size) or formulation characteristics (presence of certain excipients, compression, disintegration, coating, etc.) can mean that two pharmaceutical forms containing the same amount of active substance can be very different in terms of how that substance is delivered to the digestive system.

History

At the beginning of the 20th century, only about a dozen synthetic products and a hundred natural products were considered medicines. At the beginning of the 21st century, we use hundreds of synthetic substances, and very few common remedies of exclusively natural origin remain. The 20th century saw the rise of synthetic drugs produced by pharmaceutical laboratories. More recently, proteins, molecules of living organisms, have been increasingly used as medicines.

Development

Currently, for use in human and animal health, from the discovery of a new active substance to Marketing Authorization (MA), including the development of the pharmaceutical form(s) (the drug dispensed in pharmacies), a period of 10 to 15 years will generally have elapsed and several hundred million euros will have been invested.

Clinical studies

The various clinical studies are conducted in four phases.

Phase I

Phase I is the safety (or tolerability) phase of the product. It is generally conducted on healthy volunteers. Its aim is to establish the minimum active dose (if its activity can be demonstrated in healthy volunteers) and, above all, to establish the maximum tolerable dose, in single, increasing, and/or repeated doses. For products such as antibiotics, anticancer drugs, hormones, etc., the use of healthy volunteers is excluded. The goal is to determine the ADME pharmacokinetics of the molecule (i.e., the rate of absorption (A = the rate of passage into the bloodstream from an oral solution), M = the rate of Metabolism (biological transformation by the liver and other organs), D = the rate of distribution and allocation to different tissues from the plasma compartment, and E = the rate of elimination of the molecule by the body (also called clearance). Previously collected ADME data from animal models (rat, mouse, dog, and monkey) serve as a framework and comparison for human ADME data. Since it is unethical to expose healthy volunteers to highly active products (anti-cancer drugs, anti-thyroid drugs, hormones, antibiotics, etc.), this Phase I trial is conducted in Phase II on patients who can benefit from the presumed therapeutic effect of the tested product. In all cases, the patient's informed consent is essential. No experiment can be conducted without the patient's knowledge and informed consent, provided through explanations by the study leader.

Phase II

This phase consists of bioavailability and efficacy tests on volunteer patients. Its aim is to establish the dose-response relationship. The range of active doses is established based on data obtained from preclinical animal toxicology studies. The range of tolerated active doses is also established, without attempting to reach a maximum dose that would be toxic. This range will gradually become the dosage of the product for a given indication. It is during these tests that the first side effects are detected, which, once confirmed in Phases II and IV, will often be the main side effects of the product. If these effects are too significant compared to the therapeutic benefit, the product's development will be stopped.

Phase III

The drug whose pharmacological activity has been confirmed in Phase II must be tested to evaluate its true clinical benefit. This phase aims to establish the benefit-risk ratio. The drug candidate is compared to a reference drug and always to a placebo (when there is no ethical objection to withholding an active substance from the volunteer patient) in a larger clinical study. Randomization (a random assignment) is performed to determine which treatment arm the patient will receive. The so-called "double-blind" trial is currently standard practice (neither the patient nor the physician knows whether the drug, placebo, or reference drug is being administered). These statistical methods ensure the rigor and quality of the data generated in the study.

Phase IV

Phase IV (or post-marketing) is the long-term follow-up of a treatment after it has been authorized for sale. It aims to detect rare side effects or late complications [10]. This phase is the responsibility of the pharmaceutical companies.

Therapeutic Categories

Among medications, the following therapeutic classes are found:

• Anesthetics, for local or general anesthesia, in topical or injectable form;

• Analgesics (pain relievers), which act against pain;

• Antibiotics, antimicrobials with bacteriostatic and/or bactericidal activity;

• Antidepressants, which treat depression (see psychotropic drugs);

• Diuretics, which decrease urine production (diuresis);

• Anti-inflammatory drugs, which reduce inflammation;

• Antihistamines, which treat allergies;

• Antihypertensives, which lower blood pressure;

• Antipyretics, which reduce fever;

• Antivirals, which fight viruses;

• Antiretrovirals, which fight retroviruses;

• Cough suppressants, which suppress coughs;
Anxiolytics, which reduce anxiety (see psychotropic drugs);

• Bronchodilators, which dilate the bronchi;

• Diuretics, which increase urine production (diuresis) and lower blood pressure;

• Laxatives, which stimulate bowel movements;

• Psychotropic drugs, for the treatment of psychiatric illnesses (including neuroleptics, anxiolytics, antidepressants, etc.);

• Sedatives (calming agents), which decrease the activity of an organ;

• Vasopressors, which raise blood pressure;

Administration

Depending on its pharmaceutical form, the medication can be administered via several routes:
• Systemic administration: the active substance enters the bloodstream and is transported throughout the body to reach its target:
• Oral administration (per os): tablet, syrup, capsule, oral solution, granules,
• Suppository,
• Pulmonary administration (inhalation or instillation), with absorption through the mucous membranes of the respiratory tract
via transdermal patch (through the skin): for example, to suppress the urge to smoke, or as an anti-inflammatory or pain reliever (opioid),
• Parenteral administration is done by means of an injection. It can be:
• intravenous, as a single bolus injection or by slow infusion. The vein can be superficial, usually in the arm (peripheral venous access) or deep (central venous access), most often in the neck (jugular vein) or below the clavicle (subclavian vein). The intravenous route allows the administration of a product that must act very quickly (emergency) or a poorly tolerated product with the risk of irritating the vein (phlebitis).
Subcutaneous: under the skin, frequently in the abdomen or thighs (insulin),

• Intradermal: in the dermis,

• Intramuscular: into a muscle (thigh) for a product that needs to act slowly.

• Locally, directly onto the desired site of action:

• Ocular administration
• Vaginal/intrauterine administration, respectively through the vagina and uterus

• Dermal (topical): the active substance is applied directly to the area of the skin where it is to act: ointment, dermal cream, dermal gel, etc. (cutaneous or topical action).

Efficacy and Evaluation

The efficacy and evaluation of the drug take into account the benefit/risk balance, side effects and paradoxical effects, interactions, and contraindications. The risk profile is primarily linked to the relationship between side effects and the disease being treated.

Benefit/Risk Ratio

The benefit-risk ratio is taken into account – thus, severe side effects are undeniably more acceptable to avoid cancer than to avoid pain or obesity. From the physician's perspective, this risk assessment must consider the duration of treatment (cumulative effect) and not neglect the risk to the fetus when the patient is pregnant (for example, thalidomide, better known as Softenon). The dosage and known side effects must be listed in the package insert.

Furthermore, some medications are strictly regulated and can only be prescribed under certain conditions (see prescription, distribution). The data collected, involving a large number of patients, is transmitted to health authorities who reassess the benefit-risk balance of the medication. This reassessment may reveal serious effects that did not appear during clinical trials, potentially leading the pharmaceutical company or the regulatory authority to withdraw the medication.

Adverse Event

Adverse drug events refer to iatrogenic adverse effects that can be serious (Serious Adverse Event (SAE)), whether or not they result from a medication error.

Anaphylactic Reactions

Medications can cause an anaphylactic or anaphylactoid reaction. This is the case, for example, with acetylsalicylic acid, angiotensin-converting enzyme (ACE) inhibitors and angiotensin II receptor blockers (ARBs), penicillins, cephalosporins, contrast agents, local anesthetics, and nonsteroidal anti-inflammatory drugs (NSAIDs). Cross-reactions are possible.

Drug Interactions

A large part of the study of an active ingredient involves investigating interactions with other substances, both medicinal and non-medicinal. This study focuses primarily on cytochrome P450 enzymes, important liver enzymes.

Pharmacovigilance

After a drug is marketed, it is monitored in real-world settings. Pharmacovigilance is a system that ensures the safety of a drug by monitoring for the emergence of side effects or adverse events. Studies have identified most of these, but when a drug is used on hundreds of thousands or millions of patients, it is necessary to monitor reactions. Reassessments of the benefit/risk ratio may be conducted by health authorities, potentially leading to the withdrawal of the product.

Contraindications

Most medications have a list of contraindications for their use. These are generally medical conditions that would be aggravated by taking the medication in question.

Commercial Aspects

International Nonproprietary Name (INN) and Pharmaceutical Specialty.

Medicines are traditionally marketed under their brand name. A brand name is a form of industrial property protection, just like a patent. When a Marketing Authorization Application (MAA) is submitted to the health authorities, the brand name is subject to careful scrutiny.

A drug's brand name has lost some of its value with the development of a policy promoting generic drugs (competing drugs that are authorized after the patent or Supplementary Protection Certificate (SPC) period expires). While doctors still most often prescribe by brand name, the development of prescription support software allows pharmacists to dispense generic drugs, which are generally less expensive for the national health insurance system. This right of substitution has sometimes been considered an infringement of industrial property rights.

Drug Prices

The OECD has published its work on drug prices in various reports. Its objective is to formulate proposals that ensure pharmaceutical companies a return on investment while making drugs entering the market accessible, in a context marked by the need to limit healthcare spending.[24] The OECD has dedicated a specific report to excessive prices. The OECD notes the specific nature of drug

demand: for the most part, patients do not choose and do not pay, or only partially pay, the cost being covered by third parties. Drugs are often essential, which leads to inelastic demand. Third-party payers, insurance companies, or public health systems have limited means of control, and finally, the doctors who prescribe are neither the consumers nor the payers. This has led states to implement regulatory systems. Most of these rely on competition to exert a moderating effect on prices, particularly with regard to drugs that have lost patent protection and the emergence of generics.

Consumer countries

20% of the world's population (developed countries) consumes 80% of the world's medicines. The three countries with the highest consumption of prescription medicines are the United States, China, and Japan