

WELCOME TO PHARMA-WORLD: PHARSIGHT OF PHARMACY: A MILLENNIUM OATH

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ABSTRACT

Pharmacy is a word which runs on its two legs: chemistry & biology. Pharmacy is a harmony which has mesmerizing effect on drugs and medicines. Drug is a chemical substance which is coming from outer source having definite structural network obtained from either synthetic source, semisynthetic source or natural source [plants, animals, minerals or marine] which can fit on bio receptor platform to control the biochemical malfunction having less toxicological parameters [LD50, ED50, therapeutic index, carcinogenicity, teratogenicity, genotoxicity, neurotoxicity etc]. Drug is a formulated part called as medicine which is marketed in wholesale & retail shop stored in drug store [tablet, capsule, aerosol, cream/ointment, suppository, parenteral (large volume parenteral: LVP, small volume parenteral: SVP), transdermal, NDDS etc. The synthetic process in lab is known as wet chemistry lab and in-silico/docking process is known as dry chemistry. To find the lead compound having maximum activity with minimum toxicity is done by ADMET [administration, distribution, metabolism, excretion & toxicity] by pharmacokinetics and pharmacodynamics resembles to biochemical and physicochemical parameters of the target pharmacophore modeling. All of these follow Lipinski's rule of five RO5 [Molecular weight <500mg, logP <5, Hydrogen bond donornot greater than ≥ 5 , Hydrogen bond acceptor not greater than ≥ 10 .

KEYWORDS: Oath, Xenobiotic, Pharmacophore, ADMET, Pharmacokinetics, Pharmacodynamics, Lipinski's rule, Toxicity.

INTRODUCTION

Every drug is xenobiotic because it is coming into the body from outer source. Xeno: outer source, Biotics: active in biological system. A xenobiotic is a chemical substance found within an organism that is not naturally produced or expected to be present within the organism. It can also cover substances that are present in much higher concentrations than are usual. Natural compounds can also become xenobiotic if they are taken up by another organism, such as the uptake of natural human hormones by fish found downstream of sewage treatment plant outfalls, or the chemical defenses produced by some organisms as protection against predators.^[1-8]

Oath: An oath is a promise. An oath is a public pledge that a person will perform some action or duty, generally with the promise of doing so truthfully. An oath can also be used as a way of promising oneself to support a cause or an entity. Oaths are often done in the name of a deity–

like swearing “under God”–though this is not always the case.



Figure-1: Pharmacy symbols.

Pharma-World and the profession of Pharmacy. At this juncture, it is essential to discuss few points so that it will be helpful to clear for a fantastic journey ahead.

Pharmacist's oath: *I shall strive to perfect and enlarge my knowledge to contribute to the advancement of pharmacy and public health. I shall follow the system which I consider best for pharmaceutical care and counseling of patients. I shall endeavor to discover and manufacture drugs of quality to alleviate sufferings of humanity. I promise to devote myself to a lifetime of service to others through the profession of pharmacy.*

In fulfilling this vow: *I will consider the welfare of humanity and relief of suffering my primary concerns. I will promote inclusion, embrace diversity, and advocate for justice to advance health equity.*

I will apply my knowledge, experience, and skills to the best of my ability to assure optimal outcomes for all patients.

I will respect and protect all personal and health information entrusted to me.

I will accept the responsibility to improve my professional knowledge, expertise, and self-awareness.

I will hold myself and my colleagues to the highest principles of our profession's moral, ethical and legal conduct.

I will embrace and advocate changes that improve patient care.

I will utilize my knowledge, skills, experiences, and values to prepare the next generation of pharmacists.

I take these vows voluntarily with the full realization of the responsibility with which I am entrusted by the public.



Figure-2: Drug store.

Our purpose is to relieve patients by providing quality medicines. Let's always remember this line when we are at work in making medicines. Pharmaceutical research contributed immensely to increase the life-span of human beings 20 years on an average in last 100 years. Just think about yourself and family getting additional 20 years of life! Is it not motivating? And, we are here to contribute to that.^[9-15]

Before you start your journey, let's know –

- What's Pharmacy?
- What are the major subjects being taught in Pharmacy course (you will be undergoing)?
- How these subjects are linked to different areas of making medicines
- What's Pharmacy? It's the science, technology, art & business of making & selling medicines for the patients. Let's not restrict ourselves only to bookish knowledge and few experiments in laboratories but think about the

bigger picture. Pharmacy overall deals with disease, research, discovery, development, government approval, manufacturing, factory, packing, testing, quality, storage, distribution, sales & more. All are contributing for Pharmacy.

Are they not interdependent? Now, you can easily understand that it's (making medicine) a team-game. It needs intellect, hard-work, money, buildings, machines, chemicals, computers, guinea pigs, hospitals & so on. Currently there are nearly 3500 approved compounds (small and big sizes) which can be used as medicines.^[16-20]

- What are the major subjects taught in Pharmacy and how are those subjects linked to different areas of making medicines?

Let's discuss about the major 8 subjects/areas of Pharmacy & its impact on making medicines –



Figure-3: Medicinal chemistry.

1) Medicinal Chemistry: Paracetamol (or acetaminophen) is an organic compound having a benzene ring within it. It reduces fever. In medicinal chemistry, you will learn the synthesis of medicinal organic compounds. Most of the medicines are organic compounds. Read the label of medicine and develop an understanding (compounds present in it, mechanism of action etc) whenever you (or your family member) are consuming the same. Medicinal compounds which are present in a tablet or injection are also known as API (Active Pharmaceutical Ingredients) or DS (Drug Substance). The core idea comes that **All drugs are chemicals but all chemicals are not drugs.**^[21-25]

2) Pharmaceutics: Molecule alone is not the medicine. We have just learnt that molecules having medicinal

properties are known as API (Active Pharmaceutical Product) or DS (Drug Substance). But, you cannot give that to patient as raw. Can you eat raw potato or pumpkin? Those are to be cooked. Hence, in case of a medicine also, API or DS molecules (example is “paracetamol” which is the API or DS molecule in Calpol tablet) needs to be mixed with other substances (we call excipients) to make it acceptable to human body and for other important reasons. If you want to make paracetamol syrup (for oral intake), then add some water and sugar (will taste good) into that. Sometimes, you may think to add some preservative kind of chemicals (having antimicrobial properties) to make the solution stable for months or years. This cooking process is known as formulation. These are called as organoleptic agents.^[26-31]



Figure-4: Pharmaceutics.

The formulated products are made acceptable by mixing organoleptic agents [colouring agent, flavouring agent and sweetening agent]. And in pharmaceutics, you will be learning exactly the same – the art of delivery of medicinal molecules. Will it be in the form of tablet, capsule, injection, syrup or any other form? Hence, knowledge of physical properties of matter like dissolution, binding, molecular interaction, particles are

very important. All are being taught in Pharmaceutics or Ceutics (nick-name of Pharmaceutics!).

When, DS or API are being formulated and packed in aluminium foil (in case of tablet) or bottles (in case of syrup), it's called as Drug Product (DP).^[32-37]



Figure-5: Pharmacology.

3) Pharmacology: When medicine enters into body how does it really cure the disease and how does it (or its degraded form) being eliminated from the body – we must know. That’s the purpose of Pharmacology. Hence, physiology is the integral part of this subject. Along with that we must know body-biochemistry (like enzymes) well. While developing a medicine we have to do Animal-Toxicity-Study to ensure that it’s safe (no considerable harm to animal). Afterwards, we need to experiment with human (we call it Clinical-Trial) to prove safety and efficacy of medicinal products. Huge data originating from Animal-Study and Clinical-Trial needs proper analysis through statistics and software.

Pharmacology (or Cology) as a subject is ever expanding and deals with all these.

4) Pharmaceutical Analysis: After making a medicine, we can’t start selling unless it’s tested or analyzed to ensure its quality. In Pharmaceutical Analysis, one can learn various analytical procedures along with practicals. Remember, large number of analysis is being performed by Spectrophotometer & HPLC techniques nowadays. You can take help of youtube to learn all these which is now your virtual lab. Also, you must have a look of the book called Pharmacopoeia. All the analysis methods and expected results (or specification) for different medicines are detailed there.



Figure-6: Pharmaceutical analysis.

You must get these (Indian / United States / British versions known as IP/ USP/BP) in your library or QC (Quality Control) function or online. Start with IP (Indian Pharmacopoeia) only. “General Chapter” of any Pharmacopoeia is very interesting which detailed the principles of various analysis.

5) Microbiology: 0.9% (0.9gm of NaCl in 100ml water) NaCl or saline is an example of life-saving drug. It goes directly to blood because it is isotonic. Hence, it has to be very pure and you can’t allow any bacteria and fungus into that. There are many examples of medicines like

that. However, we need then assure the fact with proper testing methodology. Microbiology (all about knowing the “micro”-world of virus, bacteria, fungus etc) subject gives us a knowledge on how to that. Not only that, many bacteria or fungus (we may call them microorganisms) are being used to produce several medicines like antibiotics. When this is true, it’s also true – they (microorganisms) are responsible for many diseases too (like cholera, tuberculosis etc). Hence, knowing them (How to detect them, how can we use or kill them (Sterilization) for our purpose etc) is very important through the subject Microbiology.^[38-41]



Figure-7: Microbiology.

Note: Biotechnology is the more specialized and emerging area and by the application of genetic engineering, recombinant biopharmaceuticals are being

produced (by recombinant bacterial or animal cells) to treat several diseases just like biosimilars.



Figure-8: Pharmacognosy.

6) Pharmacognosy: Plant-extracts are used heavily sometimes as excipients and sometimes as medicinal agents in Pharma Industries. Guar-gum is a kind of polysaccharide extracted from a type of beans having adhesive properties. It's used as an excipient for tablet to impart binding-property so that tablet remains intact.

Let's know another example. Vincristine is an alkaloid purified from a flowering plant (*Vinca rosea*) which is used for cancer treatment (killing the cancer cells). There are hundreds of examples like these. Pharmacognosy deals with the application of plant / plant-extracts in Pharmaceuticals.



Figure-9: Pharmaceutical engineering.

7) Pharmaceutical Engineering: It's probably easy to make 2-3 gms of paracetamol in College or University laboratory with the help of commonly available chemicals, glasswares and arrangements. But, if we think to produce kgs or tonnes of paracetamol, it needs scale-up. In that case – right equipments, facilities, utilities (heat, water, gas etc) and efficient process will play

important role to make desired product with cost. Now, good engineering will come into picture.

Pharmaceutical Engineering is aiming to give us the basic understandings of engineering aspects of production.^[42-48]

8) Regulatory Affairs: While doing research (development of medicinal molecule, animal testing, human testing etc) and scale-up at Pharma Industry for commercial production of any medicine, we need to have Government approval. At various important stages of

development and regular production, Government authority (normally works under Ministry of Health) inspects the plant, process etc and issue licenses for a period of time (which can be renewed) after approving the facility.

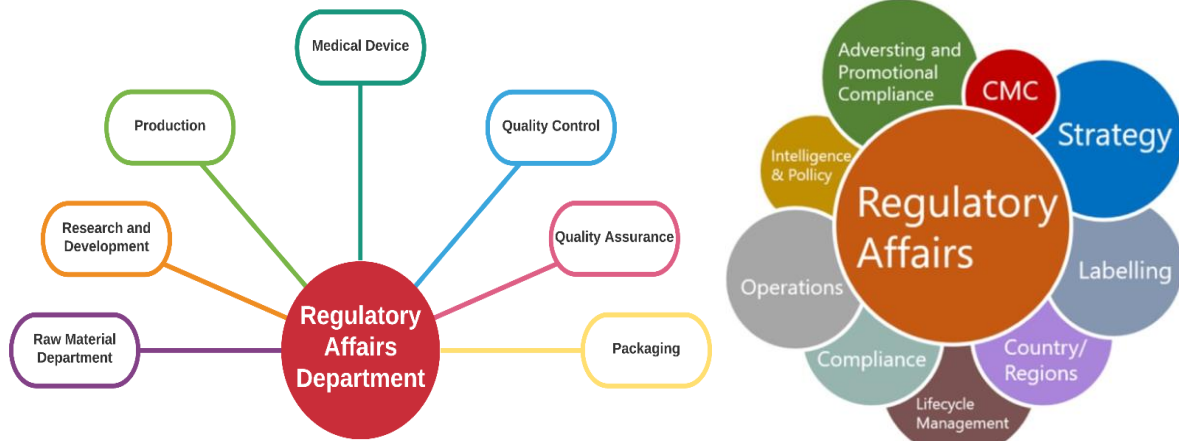


Figure-10: Regulatory affairs.

Regulatory Affairs (or RA) enables us to know these areas. Anyone can get details of drugs from these websites.

- www.cdsc.gov.in (Drug-control site for Govt of India)
- www.fda.gov (Drug-control site for Govt of USA)

9) Pharmacovigilance: Pharmacovigilance (PV, or PhV), also known as drug safety, is the pharmaceutical science relating to the "collection, detection, assessment, monitoring, and prevention" of adverse effects with pharmaceutical products. The etymological roots for the word "pharmacovigilance" are: pharmakon (Greek for drug) and vigilare (Latin for to keep watch). As such, pharmacovigilance heavily focuses on adverse drug reactions (ADR), which are defined as any response to a drug which is noxious and unintended, including lack of efficacy (the condition that this definition only applies with the doses normally used for the prophylaxis, diagnosis or therapy of disease, or for the modification of physiological disorder function was excluded with the

latest amendment of the applicable legislation). Medication errors such as overdose, and misuse and abuse of a drug as well as drug exposure during pregnancy and breastfeeding, are also of interest, even without an adverse event, because they may result in an adverse drug reaction. Information received from patients and healthcare providers via pharmacovigilance agreements, as well as other sources such as the medical literature, plays a critical role in providing the data necessary for pharmacovigilance to take place. In order to market or to test a pharmaceutical product in most countries, adverse event data received by the license holder (usually a pharmaceutical company) must be submitted to the local drug regulatory authority. Ultimately, pharmacovigilance is concerned with identifying the hazards associated with pharmaceutical products and with minimizing the risk of any harm that may come to patients. Companies must conduct a comprehensive drug safety and pharmacovigilance audit to assess their compliance with worldwide laws, regulations, and guidance.^[49-51]



Figure-11: Pharmacovigilance.

A typical Pharma Industry works as below sequence & you can choose your career in any of the functions

Table-1: Drug custody.

Sequence	Activities	Function	Remarks
1	Product Selection	Business Development	Patent Management plays a big role here
2	Research	R&D (Chemistry, Formulation, Analytical Development, Animal-Study, Clinical-Trial etc)	You can work in any of the sub-sections
3	Commercial Production	Production	DS Production, DP Production including packing are the main areas.
4	Product Approval	Regulatory Affairs (RA)	They are the interface between Govt and company ensuring compliance of various regulations.
5	Analysis	Quality Control (QC)	Ensures analysis of raw materials, DS and DP and giving results.
6	Product Release	Quality Assurance (QA)	After Production & Analysis, QA takes the decision whether to release the batch in market or not based on quality-output and monitoring throughout.
7	Pharmacovigilance	Clinical Development	It's the collection of safety data (and analysis) of the drug after commercialization of medicine.

Apart from the above, SCM (Supply Chain Management), Ware House Management, IT Management (Considering increasing application of IT in Pharma Industries), Document Management, Equipment & Facility Assurance, Safety Management, Knowledge Management, Hospital support (in Pharmacy-counter or patient counseling), Marketing /Sales etc are the areas for various Career options. Higher studies are always exciting (in national & foreign universities) as scope of research /application is being widened through the development of AI (Artificial Intelligence), personalized medicine and so on. Be Tech-

savvy. Take care of your health. With good health, you can read-understand-analyze-deliver more. You must develop values within and positive behavioral skills to improve your communication, time-management, genuinely, positivity, active-habit & more. Finally, please remember your seniors and friends here are always available and ready to help you! It's just upto us how can we approach them to learn "What", "How", "Where" and "Why"! Keep learning, keep smiling, live Life!^[52,53] So many types of equipment are all time ready to diagnose the ailments produced in the body to overcome the treatment procedure.



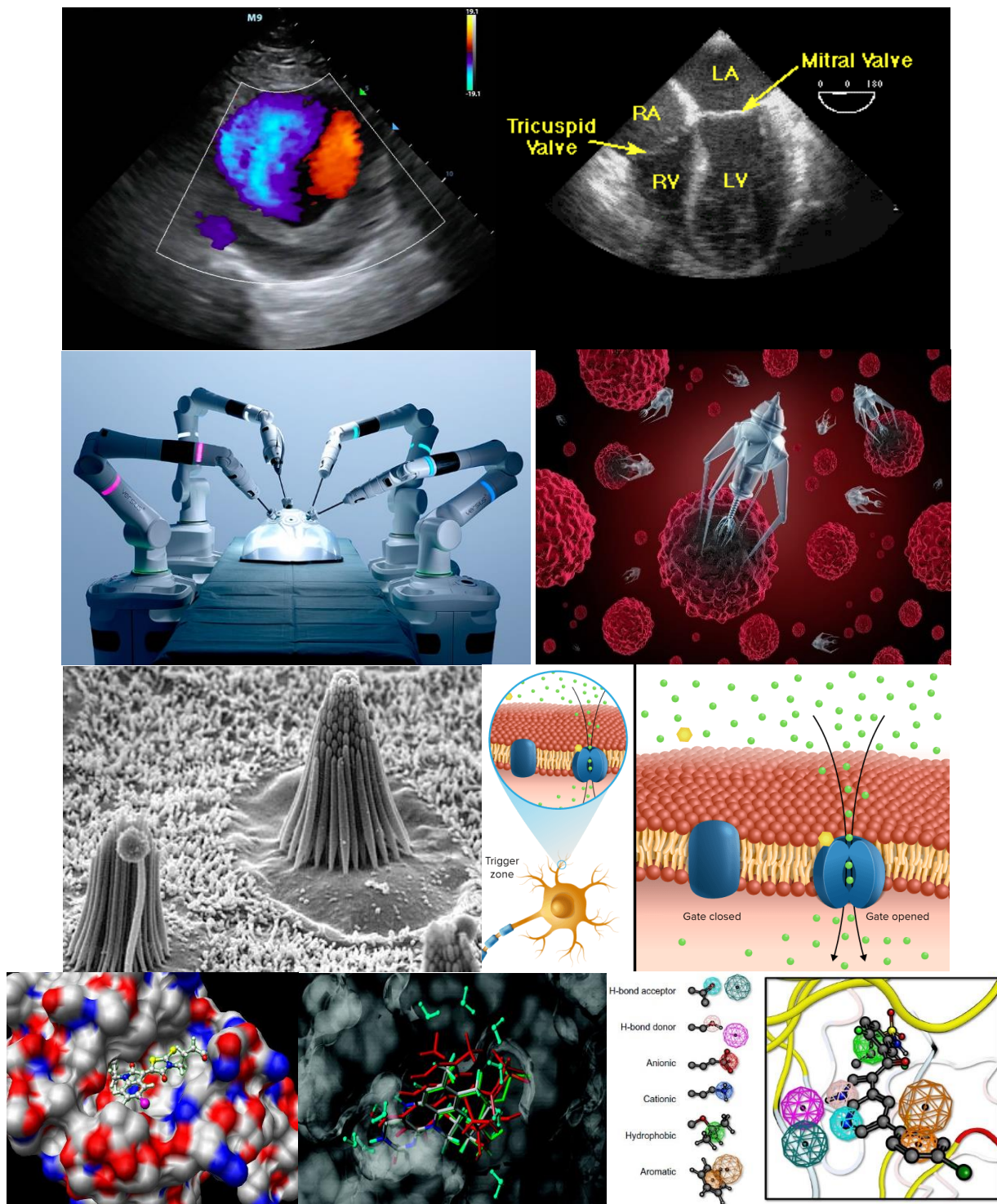


Figure-12: Newer concepts of pharmacy [MRI, CT Scan, USG, EEG, ECG, Colour Doppler, Echo cardiography, Robotic surgery, Nanorobot, Ion channel, Receptor bed, 2D Docking, 3D Docking, Pharmacophore modelling].

CONCLUSION

English alphabet consists of 26 letters which combines with each other to make words and these word join with each other to make sentences and these sentences combine to form a page and finally these pages unite to create a book. Similarly in body there are 23 amino acids which make sequence to create different creatures: human, animal, bird, fish, plant etc. All the elements of any amino acid belong to Mendeleev’s periodic table.

The creativity of either living being or chemicals are subjected to Almighty God! Sight of Pharmacy is Phar-Sight which has capability to visualize the endless end of prosperity in newer technologies for mankind. Hospital pharmacists are responsible for monitoring the supply of all medicines used in the hospital and are in charge of purchasing, manufacturing, dispensing and quality testing their medication stock along with help from pharmacy assistants and pharmacy technicians. Public

health is a multidisciplinary area which correlates various other fields so as to strengthen the quality of life. Public health practice in the modern era requires multidisciplinary approaches, where a team of public health workers and other professionals work together for the betterment of the community. Pharmacists play a vital role as an ideal professional for public health at the forefront of health care. The knowledge, skills and expertise of a pharmacist enable them to support the public health care by promoting healthy lifestyles, preventing long-term illness and by guiding patients to better manage their medicines. A community pharmacist strengthens the public health system in a broad perspective. This article focuses on role of pharmacist and the pharmaceutical industry in the public health management. Public health can be defined as "the science and art of preventing disease, prolonging life and promoting human health through organized efforts and informed choices of society, organizations, public and private communities and individuals". All the pharma professionals & healthcare persons [academics, hospital pharmacists, industrial professionals, diagnostic persons, pathologists] have a challenging future to make pharma world free of diseases which is the far-sight of healthcare professionals reflecting towards phar-sight of upcoming days. So many diseases are the creator of so many drugs and so many drugs are the creative approach on novel drug delivery system. So many types of software are now available to diagnose the disease and to start the treatment.

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World Pharmacist Day 2023 Theme. The selected theme for 2023 is “Pharmacy strengthening health systems.” This subject emphasizes how important it is for pharmacists and other pharmacy professionals to support and enhance healthcare systems across the world.

