

THE TAMIL NADU Dr. M.G.R. MEDICAL UNIVERSITY

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REGULATIONS & SYLLABUS

OF

D.M. CLINICAL PHARMACOLOGY

ACADEMIC YEAR 2024 – 2025 SESSION ONWARDS

THE TAMIL NADU Dr. M.G.R. MEDICAL UNIVERISTY, CHENNAI
REGULATIONS & SYLLABUS OF D.M. CLINICAL PHARMACOLOGY

PREAMBLE

Clinical pharmacology is the study of drugs in humans. Clinical pharmacologists are expected to have in-depth knowledge of pharmacological principles as well as clinical medicine, enabling them to provide a wide range of services to society in a variety of settings.

The focus of training of clinical pharmacology is on developing and understanding new drug therapies. Clinical pharmacologists work in diverse settings in academia, industry and government. In the laboratory setting they study biomarkers, pharmacokinetics, drug metabolism and genetics. In the office setting they design and evaluate clinical trials, create and implement regulation guidelines for drug use, and examine drug utilization on local and global scales. In the clinical setting they work directly with patients, participate in experimental studies, and investigate adverse reactions and interactions.

The DM program aims at training a physician in the specialty of clinical pharmacology, encompassing the related knowledge, skills and attitudes, so as to enable him/her to function as an independent expert and a teacher well acquainted with the applications of clinical pharmacology.

ELIGIBILITY CRITERIA

MD/DNB in Pharmacology, General Medicine, Pediatrics, Anesthesia, Psychiatry from a University recognized by the National Medical Commission.

SUBJECT SPECIFIC LEARNING OBJECTIVES

At the end of the course the candidate who is eligible for a DM degree in Clinical Pharmacology should acquire:

- a. Knowledge in the basic and translational aspects of clinical pharmacology

- b. Critical thinking, problem solving, self-directed learning and procedural skills
- c. Skills as related to formulating research questions, initiating, conducting and analyzing translational, clinical and epidemiologic research
- d. Team leadership and networking skills
- e. Communication skills necessary for working with and educating patients and team members
- f. Attitude and values that will allow him/her to provide compassionate, responsive and respectful ethical care to the participants of the clinical research/trials.

A. Theoretical knowledge

The post graduate student in Clinical Pharmacology must acquire knowledge in all aspects relevant to the practice of Clinical Pharmacology. This includes expertise in:

- conducting and guiding research to evaluate new and existing drugs (including repurposed drugs)
- advising clinicians in safe use of drugs in various special situations
- advising clinical specialists in designing protocols for and conducting clinical trials (including vaccine trials)
- functioning in clinical and research departments of pharmaceutical companies
- functioning on ethics committees for biomedical research involving human subjects (including those in pandemic situations and emergency use authorization of drugs, including vaccines for public health protection)
- advising on matters related to pharmacovigilance, pharmacoepidemiology and regulatory affairs
- setting up and running drug information centers, therapeutic drug monitoring units, drug assay laboratories and poison control centers
- setting up clinical pharmacology departments or units in their respective institutions.

B. Teaching skills

Should be able to teach relevant aspects of clinical pharmacology to resident doctors, junior colleagues, nursing, para-medical staff and other healthcare workers.

C. Research skills

Should be able to identify and investigate a research problem in clinical pharmacology, including pharmaco-epidemiological studies using appropriate methodology.

E. Group activity

Should be able to participate in multi-disciplinary meetings with experts in General Medicine, Pediatrics, Oncology, Laboratory Medicine, other allied clinical disciplines, his/her peers, and also regulatory affairs and pharmaceutical industry representatives.

SUBJECT SPECIFIC COMPETENCIES

At the end of the course, the post graduate student should have acquired the following competencies:

A. Cognitive domain (Knowledge)

By the end of the course, the post graduate student demonstrate the ability to:

- Describe and discuss the past and current literature on relevant aspects of basic and clinical pharmacology, including drug laws and regulatory affairs.
- Describe and discuss epidemiology, natural history, pathological abnormalities, etiopathogenesis, clinical manifestations and principles of management of various disorders of adults and children which will be relevant for designing and interpreting clinical trials.
- Describe and discuss designing clinical trial/research protocols applicable for various phases of drug trials, with special emphasis on Phase 1 in accordance with national/international regulations and principles of Good Clinical Practice (GCP).
- Describe and discuss individual variation in pharmacokinetics (PK) and pharmacodynamics (PD), such as genetics, age, gender, pregnancy and lactation, renal impairment, hepatic impairment and other disease and drug interactions. Plan appropriate clinical trial/research protocols applicable for all phases of drug trials, with special emphasis on Phase 1 clinical trial.
- Describe and discuss the functioning of various equipment related to pharmacokinetic studies.
- Discuss and evaluate critically literature pertaining to clinical pharmacology.
- Describe and discuss biostatistics methods so as to be able to critically read and judge new literature.
- Describe and discuss the value of ethical principles of clinical research.
- Take appropriate decision regarding hospitalization or timely referral to other consultants of various specialties during conducting clinical trials (Phase 1).
- Advise in cases of overdose or poisoning.
- Describe and discuss Pharmacovigilance programme, including the organogram and reporting mechanisms.
- Describe and discuss data science as it applies to clinical trials/research - including bioinformatics and artificial intelligence.
- Critically evaluate protocols for clinical trials, pharmaco-epidemiologic studies and other types of clinical research.
- Critically appraise research papers regarding rationale, objectives and endpoints, study design, bias control, statistical analysis, appropriateness of discussion, validity of conclusions, etc.
- Critically analyse advertising claims made for medicinal products.
- Plan, review and reconcile pharmacotherapy in consultation with faculty in charge.
- Review suspected failure of drug therapy in conjunction with clinical colleagues.
- Identify elements of drug abuse, overdose and poisoning.

B. Affective domain (Attitude-Ethics-Communication-Professionalism)

The post graduate student must:

- Demonstrate empathy for patients and their families and always treat them as worthy human beings.
- Be able to function as a part of a team, develop an attitude of cooperation with colleagues, and interact with the patient, clinicians, nurses, paramedical staff or other healthcare workers to provide the best possible solution or opinion.
- Always adopt ethical principles and maintain proper etiquette in dealing with patients, relatives and other health personnel; respect the rights of the patient including the right to information and second opinion.
- Become confident communicators so as to be able to convey therapeutic options, prognostic information, and break good and bad news to patients and their caregivers in a professional, non-judgmental empathic manner.
- Develop skills to write reports and give professional opinion and for effective teaching.

C. Psychomotor domain (Psychomotor skills)

At the end of the course, the post graduate student should have acquired skills to:

- Select drugs and adjust dosing regimens rationally based on individual factors.
- Perform an audit of clinical practice where pharmaceutical products are involved and provide appropriate feedback to clinicians.
- Develop and evaluate prescribing policies, essential medicine lists, formularies and standard treatment guidelines
- Be part of team to design hospital antibiotic policy and antibiotic stewardship activities.
- Be part of team to make effective submissions to formulary committees and regulatory authorities regarding inclusion / exclusion of new and old drugs.
- Design and conduct pharmacokinetic - pharmacodynamic (PK-PD) studies with human volunteers and population PK-PD studies.
- Design and conduct/or be part of team to conduct investigator initiated drug trials.
- Participate in various clinical trial activities like subject recruitment, administration of informed consent, randomization and blinding, clinical assessment of trial subjects, monitoring of trial conduct, reporting of serious adverse drug reactions.
- Participate in detection, reporting, management including causality assessment of serious adverse events (SAEs), adverse drug reactions, drug-drug reactions and medication errors (and report to the faculty-in-charge).
- Participate in other pharmacovigilance activity such as causality assessment.
- Monitor adverse drug reactions and report to the faculty in charge for management.
- Should be able to manage or advice regarding drug hypersensitivity.
- Be part of or participate in activities of a hospital-based drugs and therapeutics committee and other relevant hospital committees.

- Be part of or participate in activities of developing and implementing essential drug lists, formularies, standard treatment guidelines and other tools for rational drug use.

SYLLABUS

Cognitive Domain: theory

A. General pharmacology

- History of development, definition and scope of clinical pharmacology
- Basic pharmacokinetic (PK) principles - ADME (Absorption, Distribution, Metabolism and Excretion) of drugs, membrane transporters
- Studies on bioavailability of drugs including novel dosage forms, drug-drug and drug food interactions, enzyme induction and inhibition,
- Therapeutic drug monitoring – drugs requiring Therapeutic drug monitoring (TDM), dosage adjustments based on physiological or pathological changes, dose optimization strategies
- Population pharmacokinetics: sources and correlates of variability in drug concentrations in patients
- Dose response relationship, PK-PD modelling and simulation
- Physiologically-based pharmacokinetic (PBPK) modeling and simulation - the effects of extrinsic factors viz. concomitant drugs, food and intrinsic factors viz. age, organ dysfunction, disease status, and genetics on drug exposures
- Basic pharmacodynamic (PD) principles – molecular basis of drug action
- Drug disease, drug host, drug environment interactions - mechanisms and clinical importance
- Drug use in special prescribing situations – in children, elderly, during pregnancy, lactation, organ dysfunction – hepatic, renal, cardiac etc., malnutrition
- Pharmacogenomics – application of pharmacogenomics in therapeutic decision making and optimization of clinical care, precision/ personalized medicine
- Animal toxicology and PK-PD data relevant to clinical evaluation of new drugs
- Nomenclature of drugs
- Pharmaco-epidemiology - basic principles of epidemiology, study designs, confounding and bias, analysis and interpretation of data, survival analysis, propensity score methods
- Pharmaco-economics-fundamental concepts and methods, terminology, role in drug development and healthcare decision making and formulary management.

B. Systemic pharmacology

- Cardiovascular system - ischemic heart disease, hypertension, heart failure, circulatory shock, cardiac arrhythmias, stroke, hyperlipidemias and pulmonary arterial hypertension and metabolic syndrome

- Central nervous system - epilepsy, psychosis, depression, mania, anxiety, sleep disorders, general and local anesthetics, opioid analgesics, neurodegenerative disorders, drug addiction.
- Pulmonary pharmacology (common bronchopulmonary diseases. like bronchial asthma, COPD, pulmonary fibrosis and pulmonary function tests)
- Genitourinary system - kidney diseases, acute kidney injury, chronic kidney disease, renal failure, urolithiasis, benign prostatic hypertrophy and prostatic carcinoma
- Gastrointestinal pharmacology – peptic ulcer, GERD, GI motility disorders, inflammatory bowel disease, irritable bowel syndrome.
- Hepatobiliary systems, viral hepatitis, nonalcoholic fatty liver disease, cirrhosis
- Hormones and hormone antagonists – thyroid, female reproductive system, male reproductive system, adrenals, pancreas including diabetes mellitus, bone mineral homeostasis, hypothalamic pituitary axis.
- Cytotoxic and targeted cancer chemotherapy, hormones and related agents in cancer therapy.
- Immuno-pharmacology- immune-suppressants – glucocorticoids, calcineurin inhibitors, antiproliferative and antimetabolic agents, biologics, immunological reactions to drugs and drug allergy.
- Ocular pharmacology – drug delivery strategies, ophthalmic uses of drugs - antimicrobials, autonomic agents, anti-inflammatory, immunomodulatory agents, drugs for retinal neovascularization and macular degeneration, ocular adverse effects of drugs.
- Dermatologic pharmacology
- Pharmacotherapy of inflammation, pain, fever
- Chemotherapy of infectious diseases- bacterial, viral, fungal, protozoal, helminthic and other infections
- Nutraceuticals
- Clinical pharmacology of drugs used in cardiovascular, CNS, renal, pulmonary, gastrointestinal tract, infective, and other disorders
- Common malignant diseases- pathophysiology, drug targets
- Drugs for neglected diseases initiatives in India

C. Use of drugs for diagnostic purposes

- Special contrast media
- Radionuclide imaging

D. Research methodology and biostatistics

- Interventional and epidemiologic study designs
- Qualitative research methods
- Data types and choice of statistical methods
- Descriptive statistics measures and graphs
- Sample size determination and power analysis
- Parametric and non-parametric tests

- Tests for comparing proportions
- Correlation and regression
- Statistics of diagnostic tests
- Logistic regression, multiple regression
- Survival analysis
- Critical interpretation of statistical outputs including P-values and confidence intervals; multiple hypothesis testing
- Principles of interim analysis of clinical trial data
- Overview of statistical software
- Basics of data management
- Role of biostatistician in protocol designing
- Principles of critical appraisal of literature, levels of evidence and quality of evidence
- Role and limitations of evidence in development of guidelines.

E. Other aspects:

- a) Drugs and the fetus.
- b) Stem cell Research
- c) Payment to Volunteers
- d) Compensation to subjects for injury during participation in drug trials.
- e) Insurance for doctors
- f) Administration for drugs by non-medical personnel
- g) Assessment of risk and benefit
- h) Historical perspectives in human experimentation – experiments on prisoners at concentration camps.
- i) Helsinki Declaration
- j) Nuremberg code
- k) International perspectives (CIOMS – WHO guidelines)
- l) ICMR guidelines.

F. Clinical trials, BA/BE studies, Bioequivalence and allied topics

- Salient features of various phases of clinical trials, principles of controlled clinical trials, sequential trials, crossover trials, adaptive trials and registries
- Special considerations for Phase I studies – principles of First in Human (FIH) dose determination, pharmacokinetic studies, human pharmacodynamic studies, tolerance, single dose/ multiple dose, dose escalation, infrastructure requirements
- Phase II: Dose selection, study designs, selection of subjects, proof of concept studies, dose ranging studies
- Phase III: Study designs, multicenter trials, global trials, site selection
- Post-marketing studies: types of studies and their objectives, post-marketing surveillance, phase IV trials, Periodic safety update/assessment reports
- Principles and methods of Bioequivalence studies
- Multi centric studies: organization, standardization, quality control, training, protocol compliance, data processing, central randomization, issues

- Use of placebo: pharmacology of placebo, historical aspects, active/inert placebo, placebo reactors, ethics of placebo.
- Washouts and run-in periods: needs, ethics, duration
- Withdrawals, dropouts, and missing values: problems, handling of data
- Clinical trial designs including herbal medicines and AYUSH medicines – history, present status, standardization, preclinical evaluation, special issues and their solutions, regulatory aspects.
- Protocol design, Case Report Form (CRF), design of standard operating procedure (SOP) development
- Adaptive designs of clinical trials, platform trials, basket trials, umbrella designs
- Interim analysis
- Randomization, blinding and other bias control measures – need, methods, issues and their solutions
- Endpoints and biomarkers (including surrogates) – selection in specific therapeutic areas.
- Stopping rules
- Superiority, inferiority, and equivalence trials
- Per-protocol and intention-to-treat analysis
- Role of monitors, inspectors, auditors, Data Safety Monitoring Board (DSMB)
- Special considerations for bioequivalence and bioavailability (BA/BE) studies.
- Specific topics: academic trials, collaborative research, compensation for participation and trial related injury, trial insurance, compliance monitoring, quality of life assessment.
- Clinical and preclinical development of vaccines
- Clinical trials of repurposed drugs.

G. Ethics in clinical practice and research, including

- Vaccine & Biologic Trials
- Historical evolution of principles of ethics
- Principles of risk benefit assessment
- Nuremberg code, Belmont report, Declaration of Helsinki
- Indian Council of Medical Research (ICMR) ethics guidelines, ethics of pediatric research, pandemic research, research integrity and publication ethics
- Ethical dilemmas in clinical practice and research
- Role of the ethics committee, informed consent and Documentation
- Vulnerable subjects in Clinical Research & Special Population.
- Ethics of clinical practice, for e.g., resource allocation in pandemics, organ transplant, euthanasia
- Audiovisual consent.

H. Preclinical studies and their assessment

- Animal pharmacology – efficacy and safety studies, assessment of adequacy of data
- Pharmacokinetics and toxicokinetic studies
- Toxicity studies: acute, subacute, chronic

- Mutagenicity, carcinogenicity, reproductive toxicity, special toxicity studies, safety pharmacology studies, QT prolongation studies
- Good laboratory practices, OECD principles.

I. Pharmaceuticals and drug discovery

- Drug formulations, pharmaceutical equivalence
- Good manufacturing practices
- Bioavailability, bioequivalence and bioequivalence studies
- New drug delivery systems
- Screening of chemical compounds, high throughput screening
- Computer assisted drug designing
- General pharmacology and systematic screening.

J. Rational use of medicines, including:

- Pharmacoepidemiology & Pharmacoeconomics
- Principles of rational use of medicines
- Essential medicine lists
- Drug Information Centre – setting up & Functioning
- Drug Formularies, Hospital Formulary
- Standard treatment guidelines or protocols from Indian Council of Medical Research, Ministry of Health and Family Welfare and other professional bodies
- Rationality of fixed dose combinations
- Antibiotic policy and antimicrobial stewardship programs for respective medical institutions – role of a clinical pharmacologist – principles, methods, prospective audit and feedback, formulary restriction, educational interventions, guidelines, IV oral switching, dose optimization, timeouts, antibiotic use measures, special situations viz. intensive care, healthcare acquired infections, immuno-compromised patients etc.

K. Regulatory affairs, including

- Good Clinical Practice – role and responsibilities of stakeholders
- Good Laboratory Practice, Good Clinical Laboratory Practice and Good Manufacturing Practice, Other quality guidelines/ regulations – GxP (a collection of quality guidelines and regulations created to ensure that bio/pharmaceutical products are safe, meet their intended use, and adhere to quality processes during manufacturing, control, storage, and distribution)
- Drug laws applicable in India, new drug clinical trial Rules, 2019
- Structure and functions of drug control authority (Central Drugs Standard Control Organization), State Licensing Authorities
- Drug price control by National Pharmaceutical Pricing Authority, Government of India
- Emergency Use authorization of vaccines/ drugs in pandemic situation
- Regulation of nutraceuticals, medical devices, biologics and biosimilars

- Mutual acceptability of data across countries.
- Phytopharmaceuticals.
- Required for:
 - 1) New Drugs
 - 2) New use
 - 3) Actual Dosage
 - 4) Quality Control
 - 5) Procedure

L. Pharmacovigilance and allied topics, including:

- Types of adverse drug reactions
- Methods of pharmacovigilance
- Causality assessment
- Signal detection and processing, Review
- Adverse events following immunization
- Hemovigilance
- Materiovigilance
- Medication errors
- National program- PvPI, WHO program of international drug monitoring.

M. Clinical toxicology, including:

- General principles of toxicology
- Common poisons and drug toxicities
- Common environmental and occupational hazards
- Basic mechanisms of mutagenesis, teratogenesis, carcinogenesis and organ-specific toxicities
- Sources of toxicology information
- General management of poisoned patient
- Use of specific antidotes and chelating agents
- Use of specialized treatment techniques e.g. charcoal hemoperfusion, hemodialysis
- Management of envenomation e.g. scorpion or snake bites
- Aspects of analytical and forensic toxicology relevant to the poisoned patient.

N. Novel drug delivery systems and therapeutic approaches, including:

- Liposomal and nanoparticle-based drug delivery
- Inhalational drug delivery
- Monoclonal antibodies and other targeted therapies
- Gene therapy
- Stem cell therapy.

O. Miscellaneous topics, including:

- Biosimilar drug products
- Drug utilization studies
- Principles of evidence-based medicine
- Basics of bioinformatics
- Orphan drugs
- Basic and clinical contraceptive research for women and men
- Fetal medicine
- Critical appraisal of pharmaceutical promotional literature
- Clinical Trials Registry of India
- Role of government institutes, pharmaceutical industry, and academic centres in drug development collaborative efforts.
- Intellectual Property Rights and patent rights
- Setting up clinical pharmacology units – roles, infrastructure, personnel requirements.
- Drug repurposing/ repositioning
- Drug development during emergency situations viz. pandemics.

Psychomotor Domain: Practical demonstrations and skills

The post graduate student should be able to perform the following procedures independently and/or interpret the results of:

A. Should be able to perform

Pharmacokinetic exercises

- Pharmacokinetics of paracetamol in healthy volunteers using HPLC method
- Pharmacokinetics of sulfonamides in healthy volunteers using spectrophotometric method
- Modification of the dosing of phenytoin based on serum phenytoin concentration
- Design and conduct a single dose study to estimate the orocecal transit time of a given drug X in a healthy subject using sulphapyridine method
- Design and conduct a single dose pharmacokinetic study and calculate the important PK parameters of the given anti-epileptic drug / immunosuppressant drug in a human subject
- To assess the pharmacogenomic variants and use this information for dose optimization of a drug
 - Role of Pharmacogenomics in
 - a) Drug metabolizing enzymes and transporters
 - b) Drug response
 - c) Drug development and therapy
 - d) Personalised drug therapy
 - e) Pharmacovigilance

- Estimate the levels of oxidative stress markers and nitrite in a given sample
- To study the pharmacokinetics of antiepileptic drugs using HPLC method.

Pharmacodynamic exercises

- Demonstrate
- Recording blood pressure by conventional and ambulatory BP monitors
- Recording and interpretation of 12-lead ECG
- Recording and interpretation of routine lung function tests using a spirometer and assessing effects of a bronchodilator
- Effect of hand grip exercise on blood pressure and heart rate
- Hemodynamic effects of exercising on a treadmill
- Hemodynamic effects of exercising on a bicycle ergometer
- Effect of sublingual nitroglycerin on blood pressure and heart rate and exercise induced changes
- Effect of beta-blockers on isometric exercise-induced hemodynamic changes
- Effect of beta-blockers on exercise tolerance in volunteers utilizing treadmill / bicycle ergometer
- Analgesic effects of drugs in human volunteers
- Adverse effect of drugs on psychomotor performance
- Effect of diuretic on urinary volume and sodium and potassium excretion
- Effect of anticholinergic drug on salivation, pupillary size and heart rate
- Evaluation of analgesic activity of a drug using cold stress test
- Demonstration of pupillary effects of ocular drugs in healthy volunteers
- Evaluation of drug effects on cold induced hemodynamic changes.

Biostatistics exercises

- Derive & Interpret
- Sample size calculation for various clinical study scenarios
- Performance of basic parametric and non-parametric tests
- Performance and interpretation of one-way analysis of variance
- Performance and interpretation of statistical tests pertaining to 2 X 2 contingency tables
- Receiver operating characteristic (ROC) curve analysis
- Performance and interpretation of simple and multiple linear regression
- Performance and interpretation of binary logistic regression
- Basic survival analysis
- Interpretation of forest plots and critical assessment of meta-analysis.

Clinical trial related exercises

- Developing a clinical trial protocol
- Developing a BA/BE study protocol

- Developing informed consent / assent documents for a clinical trial
- Developing case report form (CRF) for a clinical trial
- Performance of various types of randomization, blinding and allocation concealment.
- Special Problems in Clinical trails:
 - a) Prophylactic drug trial
 - b) Oral contraceptives and intrauterine devices
 - c) Central Nervous system drugs
 - d) Cardiovascular drugs including diuretics
 - e) Drugs in tropical diseases
 - f) Acid peptic disease drugs.

Other clinical pharmacology and therapeutics exercises Iatrogenic Disease:

- Reporting / interpreting a suspected adverse drug reaction / drug interaction in standard format
- Causality analysis of suspected adverse drug reactions
- Reporting medication errors in prescribed format
- Need assessment, devising and implementation plans for antimicrobial stewardship activities in the hospital
- Judging the rationality of a fixed dose combination
- Judging the rationality of a therapeutic prescription
- Drawing up essential medicine lists, standard treatment guidelines and hospital formulary for various scenario
- Critical appraisal / Peer review of a clinical study report/ randomized clinical trial/ observational studies/ diagnostic and prognostic studies/ systematic reviews
- Application of principles of evidence based medicine for solving a clinical/ therapeutic query.

Teaching exercises

- Lectures classes for medical / nursing / pharmacy / dental students
- Demonstration / tutorial classes for medical / nursing / pharmacy / dental students.

B. Should be able to interpret

- Animal toxicology data that may impact human trial of new chemical / molecular entities
- Therapeutic drug monitoring (TDM) data for various drugs e.g. antiepileptics, immunosuppressants, aminoglycosides and other antibiotics, lithium etc.
- Pharmacokinetic data for modifying drug dosing in special situations like renal impairment and hepatic impairment
- First -in-human dose (Phase I dosing) from preclinical data
- Non-conventional clinical trial designs

- Reports of adverse event following immunization (AEFI), Adverse Event of Special Interest , hemovigilance reports and materiovigilance reports
- Material safety data sheets for agricultural and industrial chemicals
- Pharmacoeconomic reports
- Data from rating scales used in clinical studies in various fields like neurology, psychopharmacology, respiratory medicine, etc.

C. Procedures to perform under supervision

- Analyzing hematological and biochemical parameters using semi-automated or automated analyzers
- Pharmaceutical analysis by spectrophotometric technique (e.g. UV-Visible spectrophotometry)
- Pharmaceutical analysis by chromatographic technique (e.g. HPLC)
- Pharmaceutical analysis by immunoassay technique (e.g. ELISA)
- Basics of tissue culture
- Basics of protein / DNA / RNA extraction
- Basics of PCR and RT-PCR
- Basics of flow cytometry.

TEACHING AND LEARNING METHODS

General principles

Acquisition of practical competencies being the keystone of postdoctoral medical education, such training should be skills oriented. Learning in the program should essentially be self-directed and primarily emanating from clinical and academic work. The formal sessions are meant to supplement this core effort.

All the candidates joining the DM in Clinical Pharmacology course shall work as full-time post graduate students during the period of training, attending not less than 80% of the training activity during the calendar year, and participating in all assignments and facets of the educational process. They shall maintain a log book for recording the training they have undergone and details of the procedures done during ward and laboratory postings.

Teaching-learning methods

This should include a judicious mixture of regular bedside case presentations and demonstrations, symposia, journal clubs, clinical meetings, and combined activity with allied departments. Didactic lectures should be used sparingly.

A. Didactic lectures: Suggested up to 20 lectures per year.

Lectures on selected topics and recent advances can be taken by faculty or guest faculty. All post doctoral trainees will be required to attend these lectures. Lectures can cover topics such as:

- Research methodology and biostatistics
- Ethical issues in clinical research and practice
- Good laboratory practice
- Good manufacturing practice
- Health economics
- Recent therapeutic advances and regulatory changes

B. Journal club: Suggested frequency once in every 2 weeks.

Critical appraisal of original research articles published in peer reviewed indexed journals. The presenter will be assessed by faculty and grades recorded in log book.

C. Student symposium / Seminar: Suggested frequency once in every 2 weeks.

A broad topic will be selected and each part will be dealt by one post doctoral student. It should aim at complete evidence-based review of the topic. All participants should be graded by the faculty.

D. Bedside clinics: Suggested frequency twice every week.

To be conducted with the help of clinical departments. Faculty from the Clinical Pharmacology department should moderate the teaching-learning sessions during these clinical rounds.

E. Interdepartmental Colloquium

Monthly meeting between the Departments of Clinical Pharmacology and another department or departments on topics of current interest. Both post graduate students and faculty can present in such a meeting.

F. Clinical postings

The aim would be to acquire more in-depth knowledge in clinical pharmacology as applied to selected specialties and sub-specialties. Postings should be for 2 -3 months in:

- Broad specialty department e.g. General Medicine / Pediatrics / Psychiatry
(**Mandatory**)
- Super-specialty department e.g. Cardiology / Endocrinology / Nephrology / Medical Oncology
- Laboratory based specialty e.g. Biochemistry / Laboratory Medicine

Total duration of such posting during the three years will be for 6-9 months.

S.No.	DEPARTMENTS	DURATION
1.	General Medicine	2 Months
2.	Paediatrics	2 Months
3.	Psychiatry	1 Month
4.	Anaesthesia and Critical Care	1 Month
5.	Cardiology	15 Days
6.	Endocrinology	15 Days
7.	Nephrology	15 Days
8.	Medical Oncology	15 Days
9.	Bio-Chemistry	15 Days
10.	Lab Medicine (Microbiology & Pathology)	15 Days

G. Industry exposure

Can be arranged for 1-2 months in a company, preferably in the same city, engaged in drug development. The mandate would be to get first-hand experience of:

- Medical activities in a pharmaceutical company
- Industry specific clinical research activity, medical writing, safety reporting etc.
- Good laboratory practice and good manufacturing practice

Post graduate students who get this opportunity must share their experience in the form of a brief report, departmental presentation on completion and during the final examination.

Other aspects

H. The candidate must obtain basic life support (BLS) training and certification during the course.

- I.** Post graduate students should attend accredited scientific meetings (CME, symposia, and conferences) once or twice a year.
- J.** Post graduate student is required to participate in the teaching and training program of undergraduate students and interns and other post graduate students attending the department.
- K.** A postgraduate student of a postgraduate degree course in broad specialties/superspecialties would be required to present one poster presentation, to read one paper at a national/state conference and to present one research paper which should be

published/accepted for publication/sent for publication during the period of his postgraduate studies so as to make him / her eligible to appear at the postgraduate degree examination.

L. Log books shall be maintained regularly and should be checked and assessed periodically by the faculty members imparting the training.

M. Department should encourage e-learning activities.

During the training program, patient safety is of paramount importance; therefore, relevant clinical skills are to be learnt initially on the models, later to be performed under supervision followed by performing independently. For this purpose, provision of skills laboratories in medical colleges is mandatory.

ASSESSMENT

FORMATIVE ASSESSMENT, during the training programme;

Formative assessment should be continual and should assess subject knowledge, patient care, procedural & academic skills, interpersonal skills, professionalism, self-directed learning and ability to practice in the system.

General Principles

Formative Assessment should be frequent, cover all domains of learning and used to provide feedback to improve learning; it should also cover professionalism and communication skills.

Formative Assessment should be conducted in theory and practical/clinical examination.

Six monthly assessment during the DM training should be based on:

1. Improvement in theoretical knowledge
2. Patient based /Laboratory or Skill based learning
3. Self-directed learning and teaching

Annual formal assessment to be submitted to Dean / Principal, with recommendation from all faculty, as to promotion to second year.

The post graduate student to be assessed periodically as per categories listed in post graduate resident appraisal form (Annexure I).

SUMMATIVE ASSESSMENT, namely, assessment at the end of training

The summative examination would be carried out as per the Rules given in Postgraduate Medical Education Regulations, 2000.

The post graduate examination shall be in two parts and will be as per the details given in Postgraduate Regulations, 2000.

1. Theory:

The examinations shall be organized based on ‘Grading’ or ‘Marking system’ to evaluate and to certify postgraduate resident’s level of knowledge, skill and competence at the end of the training. Obtaining a minimum of 50% marks in ‘Theory’ as well as ‘Practical’ separately shall be mandatory for passing examination as a whole.

There will be four theory papers, as below:

Paper I: Basic sciences relevant to the discipline of Clinical Pharmacology

Paper II: Clinical aspects, diagnosis and therapeutics of major communicable and non-communicable diseases; applied laboratory technology

Paper III: Drug evaluation methodology – preclinical and clinical

Paper IV: Recent Advances in Clinical Pharmacology

2. Clinical / Practical and Oral/viva voce Examination:

Oral examination shall be comprehensive enough to test the post graduate students’ overall knowledge of the subject. The clinical/practical examination shall be held as per norms and as per the prevailing rules of the training institute/ University rules. A broad outline is suggested below:

There would be four examiners for clinical/practical examination. These would comprise of two internal and two external examiners. There should be long/ semi-long/ short/ spot cases covering different aspects of Clinical Pharmacology. The post graduate students may also be assessed for the ability to evaluate laboratory data in clinical pharmacology and *viva-voce*. The log book of procedures and interventions shall also be assessed in the practical examination. The research paper, if any shall be presented in a session.

Suggested Practical Examinations:

1. Pharmacodynamic exercises:

- a. Evaluation of effect of a drug on psychomotor performance in healthy volunteers:
 - i. Digit symbol substitution tests
 - ii. Six letter cancellation tests
 - iii. Critical flicker fusion test
 - iv. Choice reaction test
 - v. Card sorting tests
 - vi. Visual analogue scale

- b. Evaluation of analgesic effect of a drug in healthy volunteers using:
 - i. Cold pressor test
 - ii. Hot air pain model
 - iii. Radiant heat pain model
 - iv. Cola cap method
 - v. Ischemic pain model

- c. Evaluation of the effect of a given drug on cardiovascular function in healthy human subjects
 - i. Treadmill test - Heart rate and blood pressure recording
 - ii. 12 lead ECG recording

- d. Demonstrate the H1 blocking activity of a single dose of the given drug X in healthy subjects using the method of your choice.
- e. Perform the lung function tests in a given subject and record various parameters to assess lung function.
- f. Demonstrate the effect of the given drug X on salivary flow using cotton wool ball method.

2A. Pharmacokinetic exercise

- a. Design and conduct a single dose pharmacokinetic study to find the important pharmacokinetic parameters of paracetamol (1.0 gm) in a healthy volunteer. (PK parameters should be calculated both by mathematical and graphical methods).

- b. Design and conduct a single dose study to estimate the oro-cecal transit time of a given drug X in a healthy subject using sulphapyridine method.

- c. Estimate the levels of oxidative parameters and nitrite in a given sample.

2B. Calculate the PK parameters of a drug from the given experimental values.

3. Demonstration of clinical methods/ techniques

- a. Assessment of familiarity with analytical and clinical instruments/techniques
- b. Demonstrate the drawing of blood sample on a given volunteer.
- c. Demonstrate the BP measurement in the given volunteer.

4. Pharmacovigilance

- a. ADR monitoring and causality assessment.
- b. ADR reporting.
- c. Investigating a serious adverse event incidence following a drug/vaccine.

5. Critical assessment skills

- a. Critical review of a given document -
Scientific article published in a journal is provided to you. Critically evaluate the same. Write an abstract of 150 words.
- b. Comment on the ECG given to you.
- c. Comment on the prescription provided to you.

6. Critical writing skills

- a. Write an SOP on a given topic
- b. Design a clinical trial protocol for evaluation of a drug in some chronic disease.

7. Communication skills

- Oral presentation of any project work done by you
- Microteaching

8. Biostatistics

Analyse the given data using a suitable statistics test

RECOMMENDED READING

Text Books

1. Laurence L. Brunton, Bjorn C. Knollmann, Randa Hilal-Dandan. Goodman and Gilman's the pharmacological basis of therapeutics. Ed 13. McGraw-Hill Education. 2017.ISBN-13: 978-1259584732.
2. Bertram Katzung, Anthony Trevor. Basic and clinical pharmacology.Ed 15. McGraw-Hill Education. 2020. ISBN-13: 978-1260452310.
3. J. Larry Jameson, Anthony Fauci, Dennis Kasper, Stephen Hauser, Dan Longo, Joseph Loscalzo. Harrison's principles of internal medicine. Vols 1 and 2.Ed20. McGraw-Hill Education, 2018.ISBN-13: 978-1259644030.

4. Robert M. Kliegman, Joseph St. Geme. Nelson. Textbook of pediatrics. Vols 1 and 2. Ed21. Elsevier, 2019.ISBN-13: 978-0323529501.
5. Eric J. Nestler, Steven E. Hyman, Robert C. Malenka, David M. Holtzman. Molecular neuropharmacology. Ed 3. McGraw-Hill Education, 2015. 6ISBN-13: 978-0071827690.
6. Jerrold S. Meyer, Linda F. Quenzer. Psychopharmacology: Drugs, the brain, and behavior. Ed3. Sinauer Associates (Oxford University Press), 2018.ISBN-13: 978-1605355559.
7. Vincent T. DeVita Jr, Steven A. Rosenberg, Theodore S. Lawrence DeVita, Hellman, and Rosenberg's Cancer: Principles & practice of oncology. Ed11. Lippincott-Williams-Wilkins, 2018. ISBN-13: 978-1496394637.
8. Douglas P. Zipes, Peter Libby, Robert O. Bonow, Douglas L. Mann, Gordon F. Tomaselli. Braunwald's heart disease: A textbook of cardiovascular medicine. Vols 1 and 2. Ed11. Elsevier, 2018. ISBN-13: 978-0323463423.
9. John E. Bennett, Raphael Dolin, Martin J. Blaser. Mandell, Douglas, and Bennett's principles and practice of infectious diseases. Vols 1 and 2. Ed9. Elsevier, 2019. ISBN-13: 978-0323482554.
10. Thao Doan, Cheryl Renz, Fabio Lievano, Mondira Bhattacharya, Linda Scarazzini. Pharmacovigilance: A practical approach.m Ed1. Elsevier, 2018. ISBN-13: 978-0323581165.
11. Tom Brody. Clinical trials: Study design, endpoints and biomarkers, drug safety, and FDA and ICH guidelines. Ed2. Academic Press, 2016. ISBN-13: 978-0128042175.
12. Anette Müllertz, Yvonne Perrie, Thomas Rades. Analytical techniques in the pharmaceutical sciences. Ed1. Springer, 2016. ISBN-13: 978-1493981588.
13. Bert Spilker. Guide to Drug Development: A Comprehensive Review and Assessment. Lippincott Williams and Wilkins; 1st edition (1 September 2008).ISBN-13: 978-0781774246.
14. Leon Shargel, Andrew B.C. Yu. Applied Biopharmaceutics & Pharmacokinetics, 7e McGraw-Hill Education. 2016 ISBN 978-0-07-183093-5.
15. Weichung Joe Shih, Joseph Aisner. Statistical Design and Analysis of Clinical Trials: Principles and Methods Chapman & Hall/CRC Biostatistics Series, 1st edition 2015.ISBN 9781482250497.

Suggested Journals:

International and two National journals (all indexed).

