

**PHARMACEUTICS**  
**SUPPLEMENTAL EDUCATIONAL OUTCOMES**  
**BASED on CAPE 2004**

**PHARMACEUTICAL CARE** Provide pharmaceutical care in cooperation with patients, prescribers, and other members of an interprofessional health care team based upon sound therapeutic principles and evidence-based data, taking into account relevant legal, ethical, social, economic, and professional issues, emerging technologies, and evolving biomedical, sociobehavioral, and clinical sciences that may impact therapeutic outcomes.

1. Identify and explain the physicochemical and formulation properties of a drug that influence its absorption and stability.
  - a. Identify and describe the factors that influence the aqueous solubility and partition coefficient of a drug. Explain the importance of appropriate aqueous solubility and partition coefficient in the formulation design and absorption of drugs.
  - b. Understand and explain the ionization of weak acidic and weak basic drugs and calculate the fraction of a drug in its ionized and un-ionized forms as a function of pH. Describe how pKa and pH influence the observed solubility and partitioning of a drug.
  - c. Identify, evaluate, and explain the factors that affect the chemical stability of a drug under various environmental and packaging conditions.
  - d. Identify and explain the factors that control the physical and microbiological stability of a drug product under various environmental and packaging conditions.
  - e. Identify and explain the unique pharmaceutical challenges posed by contemporary biotechnology based drug products (biopharmaceuticals).
  
2. Identify and explain the properties of a drug that influence dosage form design and its route of administration.
  - a. Describe the various routes of administration available for drug delivery, and discuss the advantages and disadvantage of each delivery system.
  - b. Describe the characteristics of an ideal drug delivery system. Identify the various types of liquid, solid and semisolid dosage forms available.
  - c. Discuss how physicochemical properties of a drug influence the design of various dosage forms, including biotech drugs.
  - d. Explain the various formulation approaches taken to improve the in-vitro dissolution, solubility, stability and absorption of drugs from different dosage forms.
  - e. Identify physical-chemical and formulation properties that make a drug suitable for modified release/controlled release, and explain the various formulation approaches available for modifying drug release from dosage forms.
  - f. Discuss the methods/techniques used for establishing the performance and quality of dosage forms.
  
3. Identify and explain the dosage form features that influence therapeutic outcomes.
  - a. Describe the role and functions of inactive/inert ingredients in different types of dosage forms.
  - b. Describe the various methods of compounding and/or manufacture of different types of dosage forms.
  - c. Explain the importance of packaging and storage conditions in expiration dates and drug product quality and assurance.
  - d. Select an appropriate packaging container based on the physicochemical properties of the drug which meets a patient's need.
  - e. Explain principles underlying the proper use of dosage forms, and their influence on bioavailability and therapeutic outcome.
  - f. Determine the importance of selection of appropriate dosage form in drug therapy.

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- g. Explain the influence of formulation, physiological, and anatomical factors on drug absorption from dosage forms.
  - h. Discuss how compliance and adherence can be improved by appropriate dosage form selection.
  - i. Select and recommend the best route of administration and dosage form for a patient.
  - j. Identify and prevent drug interactions and incompatibilities based on presence of active and inactive pharmaceutical ingredients.
  - k. Identify, solve, and prevent drug therapy problems related to dosage form, delivery system, and route of administration.
4. Make appropriate selection decisions for multisource drug products.
- a. Explain and understand the concepts of pharmaceutical equivalence, bioequivalence and therapeutic equivalence. Understand the basis for therapeutic equivalence or non-equivalence.
  - b. Use the Orange Book appropriately to select and recommend a drug.
  - c. Select and recommend appropriate drug product according to scientific, legal and economic guidelines where appropriate.
5. Compound safe and effective extemporaneous pharmaceutical products.
- a. Apply relevant standards of practice (including ethical guidelines) to prepare safe and effective dosage forms and perform in-process quality control.
  - b. Search and apply most accurate and standardized information on extemporaneous compounding.
  - c. Evaluate the suitability of an extemporaneously compounded dosage form for the administration of a drug for a patient.
  - d. Identify physical and chemical incompatibilities among active and inactive pharmaceutical ingredients of a formulation; recommend and follow approaches to avoid incompatibilities and unwanted interactions.
  - e. Calculate and measure the correct quantity of active and inactive pharmaceutical ingredients.
  - f. Use correct laboratory measuring procedures to obtain the desired quantity of all formulation ingredients.
  - g. Use good extemporaneous compounding practices in the preparation of a patient-specific drug product.
  - h. Design and maintain an adequate operational facility for compounding pharmaceutical products.
6. Preparing safe and effective sterile dosage forms and enteral nutrition products.
- a. Apply relevant standards of practice (including ethical guidelines) to prepare safe and effective sterile dosage forms and perform in-process quality control.
  - b. Calculate and measure the correct quantity of ingredients for preparing a sterile product.
  - c. Use proper aseptic techniques to prepare sterile products.
  - d. Identify physical and chemical incompatibilities among active and inactive components of sterile formulations; recommend and follow approaches to avoid unwanted interactions and incompatibilities.
  - e. Use sterilization methods that are appropriate for the drug and product.
  - f. Calculate the rate of drug administration based on the prescription order and the type of infusion pump used.
  - g. Determine a patient's fluid, electrolyte and nutritional needs and calculate the composition of parenteral or enteral nutrition sources to meet their needs.
  - h. Apply appropriate quality control procedures for sterile products.

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- i. Evaluate the impact of physical and chemical stability on a sterile product.
  - j. Design and maintain an adequate operational facility for compounding sterile pharmaceutical products.
7. Maintain professional competence by identifying and analyzing emerging issues in pharmaceutical dosage forms and compounding.
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The supplemental outcomes were developed by Educational Outcomes and Objectives Supplements Task Force Members: Marc W. Harrold, Duquesne University (chair); Shelley Chambers Fox, Washington State University; Naushad Ghilzai, LECOM; Reza Mehvar, Texas Tech University Health Sciences Center; and Catherine A. White, University of Georgia.