SPECIAL ARTICLE

Teaching Pharmacology in a Physician Assistant Program

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The design of physician assistant programs creates special challenges for providing pharmacology education. The most difficult barrier is balancing the depth of the material and time constraints. Careful planning and use of an outline can facilitate lecture development. Supplemental materials are critical to the learning process and should be chosen carefully.

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INTRODUCTION

The Duke University Medical Center originated a two-year educational program for physician assistants (PAs) in 1965. Since that time, education programs have expanded to include 149 accredited PA programs in the United States.[1] The goals of the various programs, although perhaps stated differently, are similar in purpose: to educate "competent and compassionate physician assistants."

All accredited programs must meet stringent standards established by the Accreditation Review Commission on Education for the Physician Assistant (ARC-PA). There must be at least four months of classroom instruction and the curriculum must be at least one year in length. Although these programs are offered in various educational settings (eg, medical schools, hospitals, universities), they are typically completed within 24 to 27 months. During this time, PA students will receive an education similar in structure to that received by medical students in 48 months, and thus PA instruction is considered "educationally efficient."[2] Didactic education is presented at an accelerated pace during the preclinical year. The remaining months provide clinical experience that builds upon the didactic component.

Prerequisites for PA programs include college-level courses in basic sciences, math, English/writing, and some specialized science courses such as anatomy, physiology, microbiology, and/or physics.[3] Most PA students will have had little to no exposure to pharmacology.

Topics and methodology for teaching pharmacology have been reviewed for medical, dental, and nursing students.[4-9] A MedLine literature review revealed well over 100 articles on teaching pharmacology in these disciplines. However, there were no articles that discussed considerations for teaching pharmacology to PA students.

A brief review of pertinent pharmacy definitions is helpful in consideration of this topic. Pharmacokinetics describes the movement of a drug (and its metabolites) through the body. It is also thought of as "what the body does to the drug."[10] Pharmacodynamics denotes the action of the drug at receptor sites, effects caused by receptor activity, and chemical interactions. It is sometimes referred to as "what the drug does to the body."[11] Pharmacotherapy encompasses knowledge of both pharmacokinetics and pharmacodynamics and may be defined as the safe, appropriate, and effective use of drugs in treatment of disease.[12] Instruction should include the prin-

ciples of pharmacokinetics and pharmacodynamics as well as the pharmacotherapeutics of commonly prescribed medications.

In general, PAs teach the majority of courses offered at PA programs. However, pharmacists are ideal candidates for teaching the core concepts of pharmacology.[4,7] Pharmacists, typically holding a doctor of pharmacy degree, are not diagnosticians. Their skills focus on selecting the best therapeutic option once the diagnosis is made. Pharmacists are also proficient at monitoring therapeutic effects, adverse effects, and drug interactions resulting from those choices.

Pharmacists have a range of experience in preparing and presenting lectures. Some of the challenges that face the new or experienced lecturer include varying degrees of association with the PA program, understanding PA competencies, knowledge of what is presented in other clinical or diagnostic lectures, and the level of depth appropriate for training PAs in drug therapy. These challenges are relevant to many curricula but are especially pertinent during the concentrated PA preclinical year. Use of a basic lecture format can help organize information for both lecturers and students. Supplementary lecture materials are essential when classroom time is limited, and should be carefully selected.

Key Factors/Principles

Pharmacists will find that lecturing to PA students is quite different from lecturing to pharmacy students. Here we offer a perspective on content and methods for pharmacists — and other lecturers — to teach pharmacology during the preclinical year.

The first year — the "preclinical year" — is primarily didactic classroom work. Basic pharmacotherapeutics should be taught during the early stages of PA education to prepare students for patient evaluation during clinical rotations.

Several elements should be considered when providing pharmacotherapy education in a PA curriculum. First, instructors should consider focusing on concepts that are relevant to the PA's generalist scope of practice and the material should be concise and relevant.

PA programs cover an extensive amount of material in a very short time frame. Teaching sessions should strive to find the right balance between providing the necessary material without providing excessive information. Educators will need to accept that not every detail can be covered during a session and let students learn lesser details outside of class.

Lecturers accustomed to several hours or multiple class sessions for a single topic are often asked to cover the same content in a single one-to-two-hour class. It is important to continually engage students while keeping the information succinct and focusing on essential principles. Lecturers who go into great detail and present analyses of primary literature used to develop current guidelines run the risk of overwhelming and confusing students. The time is better spent delivering a focused review of the guidelines themselves. For example, it is not constructive to spend extensive lecture time critiquing the vast body of evidence supporting use of HMG CoA reductase inhibitors. It would be better to focus instead on clinically useful guidelines with a brief review of supporting data. This can be followed by a discussion of dosing, adverse effects, and monitoring of medications.

Students will benefit from lectures that provide a "big picture" approach to pharmacotherapy. If students can absorb essential principles about a class of drugs such as ACE inhibitors — which encompasses nearly ten medications — then they should be able to identify and appropriately manage that class of medications. PA students may not need to know that olanzapine is available as an orally disintegrating tablet, but they should learn to monitor patients for adverse effects such as hyperglycemia.

Students will find the material more comprehensible if similar topics are covered concurrently across courses. For example, they may better retain information if the pharmacotherapy lectures are chronologically near the diagnostic and clinical lectures. Mechanism of action is more readily related to pathophysiology while both are fresh in the mind. Antidepressant medications will be better understood if students have learned about symptomology and proposed pathophysiologic changes of depression.

Finally, as with all educational programs, consideration must be given to the different learning styles of students. Individual PA students, like all students, will respond best to different learning styles.[13,14] Effective curricula will incorporate strategies to accommodate a variety of different learners. Visual, auditory, and, when possible, kinesthetic techniques should be combined to reach all students. In addition, educators should consider the length of material. It has been documented that the attention span during a single passive activity (such as a lecture) is about 20 minutes. Lecturers should incorporate more active learning strategies throughout their lecture to retain student attention and facilitate learning.[16]

Using an Outline to Guide Lecture Format

The sheer volume of material that must be condensed into a one-hour lecture may be challenging for some

presenters. A simple outline may help guide lecture development and can also promote learning as students will become comfortable with a consistent model (see Table 1). Hypertension is offered as an example.

The Seventh Report of the Joint National Committee for Prevention, Detection, Evaluation, and Treatment of Hypertension (JNC 7) is the most widely accepted guideline for hypertension.[15] The full guideline includes detailed evidence-based information on the pharmacologic treatment of hypertension, but the authors also provide a summary document with treatment algorithms, tables, and goals of therapy. The summary document recommends initial therapy, a stepwise path for titration medications, and additional medication options. The first 10 minutes of lecture can comprehensively review the summary document, providing PA students with key elements of medication therapy.

The bulk of the lecture period — 25 to 30 minutes — will be spent reviewing medications. There are many different antihypertensives available — a drug-class-oriented approach is an efficient way to present information. Focus on the medication properties that are characteristic of the drug class and spend a brief amount of time discussing exceptions. PA students often receive pathophysiology in other parts of their curriculum, so the pharmacology lecture can provide a brief review of the mechanism of action. For example, a graphical representation of the renal tubule can be used to summarily review diuretics.

Dosing principles, such as titration and combination of agents, are more useful than rote memorization of drug doses. PA students need to learn about key monitoring parameters for the medications they will prescribe to future patients. Lectures should address laboratory values, tests, and procedures necessary to assess both toxicity and efficacy of medications. Critical monitoring for captopril (and all angiotensin converting enzyme inhibitors) includes potassium, serum creatinine, and also blood pressure. It is also important to include details about "trouble spots" — such as medications with potential for serious errors, black box warnings, or liability concerns. For example, captopril is contraindicated if bilateral renal artery stenosis is present.

Table 1. Suggested Outline for PA Pharmacology Lecture — Example: Hypertension

Lecture time (minutes)	Content
10	Review guidelines for drug therapy (if available)
25	Review classes of drugs Mechanism of action (MOA) and relevance to pathophysiology Dosing principles Major/common adverse effects (AE) Monitoring parameters, efficacy, and toxicity Briefly address "trouble spots"
10	Cases to apply information
5	Conclude with "pearls"

Lectures should include 5-10 minutes of case studies. Cases require students to actively integrate and apply the information and present an opportunity for higher-level thinking. Case studies often prompt students to ask questions and clarify points of misunderstanding. The educational literature has demonstrated that active learning techniques yield better retention of information.[16,17] Students are also generally receptive to summary "pearls," or concisely delivered points that are invaluable to clinical practice.

This outline suggests a potential way to approach teaching pharmacology to PA students. Some subjects may fit this concept more readily than others, but the general principles are applicable to all topics. The presenter can also alter the order of materials, perhaps scattering case studies throughout the lecture to continually re-engage the students.

Lecture Supplements: Clinical Practice Guidelines, Textbooks, Review Articles, Independent Assignments

Due to the intensity of the curriculum, the PA student spends a substantial amount of time reading to prepare for class. Careful consideration should be given to reading assignments, with preference given to materials that expand upon, rather than simply reiterate, lecture material. Clinical practice guidelines, textbooks, and review articles are three options to consider.

Clinical guidelines will almost always be included on PA reading lists. Guidelines usually offer a summary of the evidence behind recommendations, and PA students will be expected to practice according to the guidelines. Some medical conditions have multiple sets of published guidelines available and PA students should be directed to the most com-

monly accepted version. In addition, some conditions do not have available guidelines, requiring use of alternative references.

Textbook chapters are often assigned as reading material. They often succinctly cover important topics and include visuals such as graphs and pictures to enhance understanding. A carefully selected text can also provide the PA student with key information on different topics. Unfortunately, textbooks may lag behind the most current data and clinical practices. When no clinical practice guidelines exist, review articles can summarize information and are often more current than textbooks.

Most academic institutions have subscriptions to medical journals so that review articles are accessible to PA students. Instructors should carefully evaluate review articles, considering the reputation of the journal, background of the authors, and source of information. A well-written review published in a reputable journal can significantly enhance understanding, but a poorly written publication can lead to misconceptions.

Independent assignments are another way to supplement didactic content, requiring students to integrate and apply information from lectures and reading. This homework can be beneficial in many ways. First, it forces students to review the materials throughout the curriculum. Students may delay content review until right before a test — and "cramming" seldom leads to learning. Second, homework can incorporate the use of hand-held devices, computer databases, and other up-to-date reference materials commonly used by practitioners. Homework also provides another means of grading a student's performance.

Homework allows detection of areas of weakness prior to exams, allowing instructors to provide extra attention as needed. Finally, homework can be a means of teaching the students total patient care. Assignments can integrate evaluation of the clinical presentation of a patient, the use of diagnostic methods, and the selection of appropriate treatment options. For example, a hypertension homework assignment might include assessment of comorbidities, interpretation of guidelines, and consideration of drug therapy (see Figure 1).

Figure 1. Homework Example

A 48-year old diabetic female presents to your office for a routine physical exam. Her past medical history (PMH) is significant for hepatitis C, tobacco abuse, and hyperlipidemia. Her blood pressure is 132/88. She returns to clinic 3 days later and her blood pressure is 136/92. She should be placed on an anti-hypertensive due to her history of:

a. hyperlipidemia
b. tobacco abuse
c. diabetes mellitus
d. hepatitis C

Which class of medications would not be considered for initial therapy in this patient?

a. beta blockers
b. ACE inhibitors
c. calcium channel blockers
d. aldosterone antagonist

Based on JNC 7 Guidelines, treating individuals at the lower threshold of 130/80 mmHg should be undertaken in high-risk groups. All of the following are considered high risk groups EXCEPT:

a. diabetes mellitus
b. chronic kidney disease
c. left atrial enlargement on EKG
d. cerebrovascular disease

CONCLUSION

Pharmacology is a key component of PA education. Due to the volume of material and program time constraints, much thought must be given to content and delivery of pharmacology lectures. Many lecturers may struggle to condense their material into a manageable form and would benefit from a suggested lecture outline. Use of selected supplemental materials allows PA students to continue their education outside the classroom. It can be challenging to provide quality pharmacology education given the structure of the PA program, but careful advance planning and preparation can overcome many obstacles.

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