Currents in Pharmacy Teaching and Learning xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Currents in Pharmacy Teaching and Learning

journal homepage: www.elsevier.com/locate/cptl

Experiences in Teaching and Learning

Case-based studies in teaching medicinal chemistry in PharmD curriculum: Perspectives of students, faculty, and pharmacists from academia

Joydip Das[a,*], Julianna Fernandez[a], Dhara Shah[a], Louis Williams[a], Munder Zagaar[b]

[a] College of Pharmacy, University of Houston, Houston, TX, United States
[b] College of Pharmacy and Health Sciences, Texas Southern University, Houston, TX, United States

ARTICLE INFO

Keywords:
Medicinal chemistry
Curriculum
Case studies
Therapeutic decision-making

ABSTRACT

Background and purpose: Pharmacy practice has evolved tremendously over the years to meet the demands of the growing healthcare system. Foundational sciences like, medicinal chemistry can enhance the critical-thinking and therapeutic decision-making skills of today's professional pharmacists. The importance of medicinal chemistry for the doctor of pharmacy (PharmD) curriculum has been discussed from the perspectives of medicinal chemistry and practicing clinical faculty whose focused practices vary from infectious diseases to geriatrics.
Educational activity and setting: An Institutional Review Board (IRB)-approved perception survey and a year-end course evaluation were given to the second and third professional year students.
Findings: Eighty-eight percent of the participating second-year students and 92% of the participating third-year students thought that the introduction of case studies in the medicinal chemistry curriculum enhanced their learning and appreciation for the subject.
Discussion and summary: The *Pharmacy Curriculum Outcomes Assessment* (PCOA) exams, given at the University of Houston College of Pharmacy during the years of 2013–2015, were briefly discussed. Since the requirement to administer the PCOA went into effect in early 2016, the authors felt that not enough time existed to establish meaningful controls to conduct a correlation study with the student perspective survey results obtained and PCOA data provided in 2015. This study, therefore, highlights the importance of integrated approaches to pharmacy teaching at the University of Houston.

Background and purpose

Pharmacy practice has changed much over the past four decades to meet the needs of a growing healthcare system. The passage of land-mark legislation in the form of the Omnibus Budget Reconciliation Act of 1990 ("OBRA 90") and the Patient Protection and Affordable Care Act (ACA) have helped to establish a more pronounced clinical trajectory for pharmacists.[1] In this respect, OBRA 90 gave a new impetus for pharmacists to utilize their skills and knowledge to perform prospective drug utilization reviews and patient education. In light of an uncertain future of healthcare, the emergence of pharmacists as clinical medication experts reflects a paradigm shift in pharmacy practice activities and education toward patient-centered care.[2] This new emphasis has led to consistent restructuring of pharmacy curricula across the United States in an effort to graduate qualified pharmacists with relevant clinical

* Corresponding author.
E-mail addresses: jdas@uh.edu (J. Das), jmferna7@central.uh.edu (J. Fernandez), dnshah@central.uh.edu (D. Shah), lwilliams@uh.edu (L. Williams), zagaarma@tsu.edu (M. Zagaar).

http://dx.doi.org/10.1016/j.cptl.2017.09.004

skills. According to academic policy makers, increased clinical responsibility would mean that pharmacists would need to integrate foundational scientific knowledge (e.g., pathophysiology, medicinal chemistry, and pharmacology) into their new patient care roles. However, questions remain regarding the amount of focus subject areas such as medicinal chemistry require or whether it should exist at all in future pharmacy curricula.[3,4] This was the authors' motivation for making changes to make medicinal chemistry more relevant to patient-centered care.

This article is a case study of only one college's experience and the results of a prospective survey conducted with current students on whether incorporating case-based studies were helpful in enhancing their interest in the medicinal chemistry discipline and positively influencing their pharmaceutical basic-science knowledge along with their abilities to apply the basic principles learned to making better patient therapeutic decisions. A discussion of these survey results is also presented from the perspectives of practicing clinical faculty with focused practices in infectious diseases and geriatrics as well as from the perspective of medicinal chemistry teaching and research faculty. The article begins with a discussion of the evolution of patient-focused pharmacy practice.

The evolution of pharmacy to patient-centered healthcare

The contemporary pharmacist is trained to provide advanced medication management services, which requires a unique combination of clinical proficiency and knowledge of pharmaceutical sciences (e.g., medicinal chemistry).[5] The relationship between pharmaceutical sciences, which includes medicinal chemistry and medical practice, is not entirely unprecedented. The pioneers of modern pharmacy practice were often medical practitioners that relied on an understanding of natural medicinal ingredients to provide patient care. A prime example of this can be traced back to the ancient civilizations across Asia, Europe, and the Middle East, that linked rudimentary medicinal chemistry directly to the practice of medicine.[6] In the 19th century, pioneers such as the immunologist Paul Ehrlich helped to further define medicinal chemistry into two sub-disciplines (i.e., pharmacognosy and pharmacotherapy) separating drug discovery from pharmaceutical application.[7] The industrial revolution at the dawn of the 20th century further separated the practice of medicine and pharmacy into two disciplines that eventually grew apart, with physicians inheriting the role of the traditional patient-care provider and the pharmacist largely relegated to the role of pharmaceutical supplier or medication dispenser.

However, this trend has reversed in recent times as contemporary pharmacy practice has evolved to encompass advanced medication-management services that require a unique combination of both clinical proficiency and knowledge of basic pharmaceutical sciences such as medicinal chemistry. Nowhere is this more evident than with the changes that have occurred over recent years at the University of Houston College of Pharmacy (UHCOP) within its doctor of pharmacy (PharmD) program. To achieve the goal of a patient centered healthcare learning experience, the college is in the process of initiating a new patient centered disease based fully integrated curriculum to achieve an outcome consistent with a major component of its overall mission to "provide a comprehensive education that prepares students for pharmacist-delivered patient care in a diverse healthcare environment."

With all these changes, coupled with the amount of required experiential content (introductory pharmacy practice experiences [IPPEs]), administrators are reevaluating the relevance of certain foundational basic science courses, including medicinal chemistry. The authors propose that medicinal chemistry is a cornerstone subject in the PharmD curricula because it introduces foundational knowledge and critical-thinking skills for the provision of patient-centered care.

Use of case-based, problem-based learning activities encourages students to contextually utilize fundamentals of medicinal chemistry, such as structure activity relationships, physicochemical properties, and kinetic principles in their clinical training.[8] Incorporation of distance education technology and student-centered learning methods into courses complement the traditional textbook case studies found in textbooks such as *Foye's Principles of Medicinal Chemistry*.[9–12] Case-based activities were designed to emphasize medicinal chemistry as a visual science that helps students solve problems and consider fundamental drug properties in their therapeutic decisions both in the classroom and in the surrounding communities of the University of Houston.

These case-based activities are also designed to vertically and horizontally integrate key medicinal chemistry concepts within other PharmD didactic coursework as well as IPPEs and advanced pharmacy practice experiences (APPEs).[13] Therefore, incorporating successful experiences within medicinal chemistry utilizing these case-based and problem-based learning activities during the formative second and third professional years of the PharmD curriculum can be crucial for making informed therapeutic decisions after entering practice.[14]

Educational activity and setting

Starting in fall 2013, a modified way of delivering medicinal chemistry course content was presented to UHCOP students graduating in the class of 2016. This represented the first introduction of patient-based case studies and discussions as a form of active learning with the expressed goal of enhancing critical thinking skills. Two courses, Medicinal Chemistry I and Medicinal Chemistry II are taught to the second professional year (P2) students in the fall and spring semester, respectively. The cases discussed in class and placed on each exam were modified versions derived from the cases at the end of each chapter of Foye's sixth and seventh editions of *Principles of Medicinal Chemistry* and its online resources.[11] An example of such a case can be found in Appendix A.

Prior to 2013, the focus of medicinal chemistry was through the presentation and emphasis on basic principles related to drugs (e.g., properties, stability, absorption, distribution, metabolism, and elimination) and new sources of natural product leads for drug development. Little or no emphasis was on what these principles had to do with patient-centered care.

With the introduction of the case studies in the courses Medicinal Chemistry I and Medicinal Chemistry II, an Institutional Review Board (IRB) approved survey was conducted for the year 2015 and given to the second professional year class (P2 graduating class of