Approaches to Education in Nuclear Pharmacy

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Nuclear pharmacy has been recognized as a specialty practice for over 20 years. The field has changed from a few innovative pharmacists with advanced degrees located in larger hospitals to a network of centralized commercial nuclear pharmacies located in cities across the USA. Various educational approaches have been developed to provide the knowledge base required to work in a nuclear pharmacy. Educational approaches, advantages and disadvantages, are examined in this article. In addition, the concept of a generalist Doctor of Pharmacy first professional degree is examined in relation to current academic programs in nuclear pharmacy. The potential impact of the philosophy of the first professional degree upon the provision of nuclear pharmacy personnel is addressed.

INTRODUCTION

In recent years the awarding of the PharmD degree as the first and only professional entry-level degree has gained considerable support. Acceptance of the PharmD degree has coincided with the promotion of pharmaceutical care as a new philosophy of pharmacy practice. In addition, the position has been taken that the Doctor of Pharmacy degree should prepare pharmacists for entry-level practice rather than specialty practice[1]. As faculty in schools of pharmacy review and consider curricular revision for the PharmD as the only entry-level professional degree, it seems timely to examine approaches currently taken to educate pharmacists for the specialty practice of nuclear pharmacy. Since being recognized as the first specialty practice by the Board of Pharmaceutical Specialties in 1978, nuclear pharmacy has been a leader in developing eligibility requirements, procedures and a certification examination to award board certification[2]. The experience gained by nuclear pharmacy has been very useful in the development of recognition now accorded other specialties in pharmacy.

While reviewing educational approaches in nuclear pharmacy, it is important to realize that a nuclear pharmacist is first of all a pharmacist having the same basic level of competence and background expected of all entry-level first professional degree pharmacists. Of course, nuclear pharmacists must gain additional knowledge and practice skills expected of pharmacists that are recognized as specialists(3). The nuclear pharmacist must function in the same manner as the vast majority of pharmacists: *i.e.,* prepare and provide products, dispense the correct dose to the right patient, monitor for adverse reactions and for therapeutic drugs that may affect the biodistribution and/or pharmacokinetics of a radiopharmaceutical. The nuclear pharmacist must understand the expected outcomes from a nuclear medicine procedure as related to the radiopharmaceutical. The nuclear pharmacist must be an expert on therapeutic agents that are used in certain nuclear medicine procedures to enhance the usefulness or to increase the efficiency of the procedure. Drug utilization review, drug use evaluation, patient counseling and other aspects of pharmaceutical care are relevant to radiopharmaceuticals and nuclear pharmacy just as for other areas of pharmacy practice(4).

The level of knowledge and capabilities required to practice in nuclear pharmacy is somewhat dictated by the practice environment. For example, a nuclear pharmacist located in a commercial centralized nuclear pharmacy is not likely to be expected to perform the same functions as a nuclear pharmacist in a major medical center. Most commonly a nuclear pharmacist in a medical center will have an advanced degree while a nuclear pharmacist in a commercial centralized pharmacy can satisfy the practice requirements with a first professional degree. However, in either situation the nuclear pharmacist must have a knowledge of the fundamental principles of nuclear physics, radiation detection instrumentation, radiochemistry, radiation protection, radiation biology, product preparation and dispensing as well as other essential concepts relevant to nuclear pharmacy. This knowledge base and practice experience in nuclear pharmacy are beyond the core requirements for the entry-level professional degree. The added knowledge is essential to assure quality professionals in nuclear pharmacy as well as to meet the requirements of the Nuclear Regulatory Commission (NRC). The nuclear pharmacist must be authorized by the NRC to receive, handle and dispense radioactivity. Recently, requirements to become an "authorized nuclear pharmacists" have been promulgated and published in the Federal Register(5). A total of 700 hours in a structured educational program consisting of both didactic training and supervised experience in a nuclear pharmacy or board certification as a nuclear pharmacist meet the NRC training requirements to be an "authorized nuclear pharmacist." To be eligible to sit the exam to become board certified in nuclear pharmacy a pharmacist must have a minimum of 4000 hours (contact) that can be attained by various combinations[2].

Approaches to education in nuclear pharmacy will be addressed from several viewpoints: the method of obtaining the specialized knowledge base; the educational advantages and disadvantages of each method; and economic considerations. Also, the impact of a generalist only first professional degree on the availability of nuclear pharmacy personnel and nuclear pharmacy education will be addressed.

EDUCATIONAL APPROACHES

Elective Series in the First Professional Degree

The pharmacy student may obtain the fundamental knowledge necessary to enter nuclear pharmacy through a series of elective courses while completing a first professional degree program. There are several advantages to this approach. The student learns the material at a reasonable pace with a degree of repetition and reinforcement. The student may have an opportunity to gain practice experience through a summer internship or as part of an externship. Having been exposed to multiple courses and a practice experience the student is aware of the negative and positive aspects of nuclear pharmacy practice. The student may discontinue the elective series at any time. Thus, at graduation a student entering nuclear pharmacy has a high probability of retention. A student that does not complete the entire series of elective courses can still benefit from a greater understanding of the importance of diagnostic imaging in pharmaceutical care and drugs associated with procedures.

The elective series approach allows for a large number of students to be prepared as specialists each year. The cost to an employer is minimal and may be only through support of an internship or externship program. The expense to the university may be significant as faculty, laboratory equipment and physical facilities are required to teach the fundamental principles for nuclear pharmacy. Also, the graduate is not required to enter nuclear pharmacy thereby potentially reducing the return on investment by the university. However, the graduate is still competent and prepared for many other areas of pharmacy practice. The curriculum must allow a student to participate in a multi-course training program without detracting from the goals of the core curriculum. The graduate with specialty training must be as qualified as the other graduates entering pharmacy practice.

Postgraduate Short Courses

Although several pharmacy schools offer nuclear pharmacy education at the undergraduate level, there are not sufficient numbers of qualified practitioners available. Also, traditional programs cannot meet personnel shortages that arise from unexpected pharmacy turnover at odd times of the year; *Le.,* other than May. As a supplementary means to meet the demand, short courses have been developed to offer intensive education over a short period of time. The course may be structured to last five to six consecutive weeks at a training site or for two-week intervals followed by practice in a nuclear pharmacy for a total of six weeks of didactic training. Another approach utilizes the concept of a certificate program where the trainee uses videotapes and workbooks for self-study while working in a nuclear pharmacy followed by a two-week session at the school of pharmacy.

Short courses are offered by universities, private corporations or by a centralized nuclear pharmacy corporation to their employees only. The short courses are available to licensed pharmacists that wish to elect a career change and enter nuclear pharmacy practice. The advantages to the pharmacist are a relaxed admission criteria and minimal time commitment compared to a graduate program or a residency in nuclear pharmacy. Often the employer will pay for the course in exchange for the pharmacists services for a set period of time. Since it is essentially a single course, there are greater ramifications for the pharmacist who wishes to withdraw from this type of program than for a student who has partially completed the sequence in the multiple-course undergraduate program. The licensed pharmacist may suffer financial and career losses upon abandoning the program. Because the licensed pharmacist may make a decision to change career direction with a lesser depth of information about nuclear pharmacy than the undergraduate taking a series of courses, future job satisfaction may not be as great and the potential for retaining the pharmacist in nuclear pharmacy may be reduced. Because of the intensive nature of the training, the pharmacist has less time for repetition of course content and might not be as comfortable with his or her entry level competence compared to trainees from more protracted and extensive programs.

The advantage of short courses to the pharmacy employer is that a greater number of people can be trained as needed in a shorter period of time. The employer no longer needs to wait for the yearly group of pharmacy graduates from schools of pharmacy. Corporations can use the short course for company orientation as well as nuclear pharmacy training. The employer may reasonably expect to retain a pharmacist trained with company funds until the terms of the employment contract have been met.

Residency

A pharmacist with a first professional degree may enter nuclear pharmacy practice through a residency program. The residency is usually one year and takes place in a medical center. By the nature of the location, the residency has a greater clinical component than undergraduate programs or short courses. If the resident has not obtained the fundamental knowledge elsewhere, didactic material must be provided through courses taught by the nuclear pharmacy staff or by other professionals that teach nuclear medicine physicians or technologists. The level of competence and potential for retention attained by the resident should be high after an entire year of experience within a nuclear pharmacy located in a nuclear medicine department. The training program requires a considerable commitment from the supervisory pharmacist and is limited in the number of individuals that can be trained at one time. Difficulty in identifying sources of money for resident support is another problem encountered in this approach to education. Also, the resident must commit one year at a reduced salary.

Master of Science Degree

Some pharmacists elect a MS degree program as a means to enter nuclear pharmacy practice. The MS degree allows considerable opportunity for the pharmacist to become well schooled in the knowledge base needed for practice as well as the development of basic research skills. During the period of 1.5-2.0 years required to accomplish the requirements of an MS degree, the pharmacist relinquishes immediate earning potential during training. However, the scope of the practice is expanded through preparation to conduct research. The added knowledge gained through the MS degree allows the pharmacist to participate in teaching and increases the potential for employment in a large medical center. A MS degree program may be directed to the more traditional practice of nuclear pharmacy or emphasize the preparation, dispensing and clinical applications of radiopharmaceuticals used for positron emission tomography (PET) imaging. Both areas require time devoted to practice/clinical experience either through a speci-

fied time period or integrated throughout the MS degree program. A MS degree requires the availability of advanced level courses, research facilities and a faculty capable of directing the program. It is an expensive endeavor on a per student basis.

DISCUSSION

To enter the practice of nuclear pharmacy a pharmacist must have at least the minimum knowledge base required by the NRC and have practice experience gained under the supervision of a nuclear pharmacist. While this knowledge can be obtained through advanced graduate education or by a residency, over 90 percent of the nuclear pharmacists practicing in a centralized commercial nuclear pharmacy have a first professional degree only[1]. The most common approach that has been used to gain the required fundamental knowledge has been through a series of elective courses available during the first professional degree or through a short course available to licensed pharmacists. Interestingly, of the 288 board certified nuclear pharmacists as of August, 1994, less than 20 percent have an advanced degree[2]. It appears that the basic principles required to enter the practice of nuclear pharmacy are adequate to allow the pharmacists to build the knowledge and competency skills required to successfully complete the board certification exam.

Over the years, the undergraduate elective series and short course approach have provided a large number of pharmacists entering the practice of nuclear pharmacy. The number of advanced degree programs available is small and limited in graduating a significant number of individuals simply because of the cost of graduate education and the small numbers of pharmacy graduates willing to continue for an advanced degree. While at one time there were three residencies in nuclear pharmacy, at this time there is one residency located in a medical center, administered by a college of pharmacy, and one other based in the military. The demand for nuclear pharmacist continues because of new radiopharmaceutical products, expansion of commercial nuclear pharmacies and turnover as is normal for all areas of practice.

Nuclear pharmacy as a specialty faces a potential dilemma if, indeed, schools of pharmacy determine that a generalist PharmD program does not allow sufficient flexibility for tracking during the first professional degree. Knowledge and experience must be gained by the pharmacist to be considered as an "authorized nuclear pharmacist" by the NRC. If students in schools of pharmacy are precluded from obtaining this knowledge, then only short courses will be available for pharmacists wishing to specialize in nuclear pharmacy. While the short course approach is beneficial and necessary because of the limitations of academic programs, the loss of academic programs in nuclear pharmacy would be most deleterious to the specialty. Academic programs foster innovation and change. Academic programs allow for variability and differences that are beneficial to the practice as a whole. Scholarly works are natural aspects of an academic program. In addition to providing personnel for nuclear pharmacy practice, academic programs in first professional degree programs foster an awareness of the importance of imaging in pharmaceutical care. Because of elective courses and faculty in nuclear pharmacy all students in the school are exposed to a broader understanding of diagnostic imaging and drug products employed in procedures.

In an article on resources and risks of specialization(6), it was noted that specialty tracking within first degree programs presents a risk to students such as making decisions without having first developed a conceptual basis of pharmacy practice and being unprepared to integrate their specialized skills into the mainstream of the profession. With appropriate design, specialty courses can be available in a curriculum that will allow a student to gain the additional knowledge without detracting from the core material required to produce a quality entry-level generalist. In fact, the specialty courses in nuclear pharmacy can add skills that are in concert with the mainstream of the profession. The students learn product preparation and distribution functions as well as the importance of proper product labeling and the right drug to the right person. Communication skills are developed. Drug-drug and drug-radiopharmaceutical interactions are of concern. The importance of determining the desired outcome from a diagnostic radiopharmaceutical used in a nuclear medicine study or a therapeutic drug used to enhance the efficacy of the study are critical concepts learned in specialty courses in nuclear pharmacy. A student with the differential knowledge gained through a specialty track in nuclear pharmacy may indeed be enriched in mainstream practice and play a significant role in bringing pharmaceutical care to diagnostic imaging(4).

Specialized residencies provide an excellent approach to the preparation of high quality, clinically oriented specialists. The concepts and advantages of specialized residences have been well documented(7-9). Specialty residencies should be increased in number, but not at the expense of differentiation tracks in an entry-level PharmD curriculum. Differentiation tracks allow the provision of significant numbers of students with a knowledge base that can be expanded to allow the pharmacists to grow professionally and even attain the status of board certification. Differentiation tracks can not be offered by all schools in all areas, but can be useful in a school with faculty and resources in a given area. Curricular design allowing differentiation benefits specialization areas recognized today and the development of new areas by innovative faculty in the future.

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