Commentary

Research as an Integral Part of a Nuclear Medicine Technology Curriculum

Research is the keystone to new advances. This is particularly apparent in the continuously developing field of nuclear medicine where, for example, the use of radiopharmaceuticals in clinical settings depends on previous preclinical and selected clinical trials. As part of the nuclear medicine team, the nuclear medicine technologist must be able to conduct and assist in research activities. In order to prepare the nuclear medicine technologist for this role, a course has been developed at the University of Nebraska Medical Center to teach students research techniques. It is now a required course in the nuclear medicine technology professional curriculum.

This course was developed after the Research Committee surveyed the faculty in the School of Allied Health Professions (SAHP) to determine interest in multidisciplinary research by both faculty and students. A twenty item forced choice questionnaire, in which respondents were required to answer items on a 1–5 or 1–3 value scale in order to avoid a "not applicable" answer, was mailed to all individuals holding a faculty appointment in the SAHP at a rank of assistant instructor or above.

Forty-nine faculty members returned completed questionnaires for a response rate of 77% for full-time faculty and 37% for all faculty. The majority of students were not presently involved in research and did not take an introductory research course. Faculty perception of students' research needs indicated that an interdisciplinary course offering on research was desirable. The faculty agreed that students should know how to perform research but were undecided on whether actual performance was necessary.

In response to these results (Table 1), an interdisciplinary research course has been developed for two semester hours credit, meeting two hours weekly. Because no other similar course in undergraduate studies at other colleges and universities was found in the literature, the course content is based on instructor knowledge of research and graduate research course content.

COURSE DESCRIPTION AND METHODOLOGY

The course is offered during both the fall and spring semesters with students from nuclear medicine technology, radiography, diagnostic medical sonography, radiation therapy technology, and medical technology enrolling in the fall. Approximately 20 students are enrolled in each course offering. The author instructs and coordinates the fall course while another allied health instructor conducts the spring semester course. Nuclear medicine technology students enroll in the fall course because it allows time to conduct their research during the spring semester. Utilization of instructor prepared documents consisting of definitions, examples, and procedure listing replaces a textbook.

The main goal of the course is for each student to become knowlegable about the research process upon completion of the course. In order to accomplish this goal, each student prepares an abbreviated research proposal during the course. This abbreviated or mini-proposal incorporates all facets of a proposal with the following exceptions: references are limited to a total of three and there is no cost analysis. The development of this proposal is guided and monitored throughout by the course instructor. The course content is designed to familiarize the student with the requirements of research proposal submission as well as methodology. A weekly course is outlined is as follows:

Week 1—Introduction and pre-assessment of research and statistical knowledge.
Week 2—The research proposal.
Week 3—Ethics and the Institutional Review Board/Animal Review Committee (IRB/ARC).
Week 4—Safety Considerations; Reviewing the Literature.
Weeks 5 and 6—Research Designs.
Week 7—Class work time on research proposal.
Week 8—Examination.
Weeks 9–11—Statistics.
Week 12—Use of computers in research.
Week 13—Critical reading/writing; Quality Assurance.
Week 14—Class work time on IRB/ARC proposal.
Weeks 15 and 16—Oral critical article reviews.
Week 17—Examination.

For ease of explanation, this discussion will not follow the course in sequence but will separate the out-of-class assignments from the class presentations.

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Table 1. Abbreviated Survey Questions and Faculty Responses

Survey items	% Faculty Agreement	
	Full-Time	All
1. Faculty developmental seminars	100.0	91.9
2. Faculty attendance at developmental seminars	94.1	75.5
3. Emphasize research at the faculty level	88.2	91.9
4. Emphasize research at the student level	82.3	81.7
5. Research endeavors are necessary for SAHP survival	76.4	81.7
6. Annual research forum for allied health students	88.2	87.8
7. Presently, our students perform research	41.1	36.7
8. Presently, our students take an introduction to research course	35.2	28.6
9. Make available an interdisciplinary research course	82.3	87.7
10. Students should know how to perform research	88.2	89.8
11. Students should perform research	53.0	65.4
12. Faculty need to perform research	70.6	51.1
13. Students have time for a research class	53.0	47.0
14. Computer support is available	58.8	51.0
15. Clerical support is available	17.6	20.4
16. Financial support exists	47.2	36.7
17. Equipment is available	58.8	57.1
18. Faculty too involved to do research	29.3	46.9
19. Faculty too involved to advise students	29.3	38.7
20. Faculty research efforts underway in 36 projects	—	36.0

Class Presentations

The first class session serves as an introduction to the importance of research. It also assesses the student's present knowledge of research and statistics through a short pretest, requiring simple computations and responding to open-ended questions. These results serve as a basis for the classes on research design and statistics.

The components of the research proposal are covered and are organized according to the requirements for research grants including: Title of Study; Name of Investigators; Specific Aims of Study; Significance: Literature Review; Plan of Study (Sample, Method, Design, Analysis); Time, Space and Equipment; Cost Analysis; References and Bibliography; and Appendices. These serve as the unifying structure for the course, because as each new topic is presented, it is related to the proposal components. A reference librarian reviews the use of the library for a literature search with and without computer assistance. Individual aid is offered as the student begins a search.

Before addressing research design and statistics, classes are presented by invited speakers on ethical and safety considerations for animal and human research. Safety factors include personnel safety with regard to physical and chemical hazards, as well as safety for the research subject. Ethical considerations are introduced by the review committee executive secretary who discusses the history of the development of IRBs and ARCs, completion of application for research approval, the importance of informal consent, and the necessary components for oral or written consent. Research design sessions concentrate on experimental, observational, correlational, and pre-experimental research. To demonstrate populations and sampling from populations, pieces of candy are used as a population with various sampling techniques. Examples from specific studies also are given.

An unconventional approach to the concepts of statistics is to require computation for only the mean and no use of other formulas. The reason for the nonuse of formulas are the availability of computers for analysis and statisticians for consultation. A series of definitions is discussed with liberal examples to relate them to the student's area of study. Discussion includes descriptive and inferential statistics and which types of analyses are most appropriate for interval, nominal, or ordinal data depending on whether interest is in comparing, describing, or relating these data.

Class presentation on the use of computers in research provides an overview of available personal computer hardware and software for networking, word processing, data base management, graphics, compiling data from equipment, and statistical analyses. The necessity for quality assurance to extend from clinical practice to research is emphasized and demonstrated. Journal article structure and review are conveyed in lecture style.

Using the considerable information that has been presented about research in this class, the student is now able to critically analyze a research article. Two or three students are assigned an article in their area of study. A prescribed written review format is completed, and an oral discussion of the article includes specific areas such as purpose of the study, author's hypothesis, research design, research methods, statistics used, findings, conclusions, and the student's critique of the study. This activity culminates the course.

Out-of-Class Assignments

The out-of-class development of a mini-proposal begins by asking the student to prepare an idea for a research study. The instructor reviews the concept, confers with the student, and returns it with comments which usually narrow the idea to a more concrete and manageable project. Students have a broad idea of their research such as improved bone imaging but have not considered all the variables (i.e., the patient, radiopharmaceuticals, instrumentation, and computer). Furthermore, they have not considered which variables to keep constant or the factor within each variable to study. Familiarity with the library leads to the next step in the proposal—finding three recent articles pertaining to the research idea, preferably using a computer search mode. These three references with abstracts of their contents are reviewed by the instructor. Careful monitoring of the student's progress is needed so that the student does not become frustrated with a literature selection which is too large or too small. The research idea is also modified as needed depending on the literature finding.

As the class presentations continue, the student is next required to have completed the following sections of the proposal: Title; Name of Investigators; Specific Aims; Significance; Literature review; and Plan of Study, excluding statistical considerations; and References. Again the instructor

reviews this and discusses the proposal with the student. The Plan of Study is usually modified as statistics are discussed. After statistical information is presented, the proposal development now includes Plan of Study with statistical considerations, and Time, Space, and Equipment discussions. The only area of the proposal which is not completed is the Cost Analysis. If a student decides to conduct the research, then cost is discussed.

After the proposal is returned, one other step must be completed. Because the students usually choose to write a proposal for human research as opposed to animal research, each student completes the required IRB and informed consent forms in order to have a review of the proposal and approval for its initiation and completion.

Some unique and well thought out proposals have been developed by the students. Examples of student research ideas include:

1. How does breast cancer affect the relationship between a man and woman?
2. Does a new test for diagnosing lupus compare favorably with the present test used?
3. Does a patient receiving a complete C spine series of x-rays receive more radiation from a fluoroscopy unit used for positioning or from a unit with no fluoroscopy but frequent film retakes?
4. What is the effect of smoking on gastric emptying?
5. Does ingestion of water or caffeinated beverages prior to imaging provide better bone image resolution?
6. How accurate is the body landmark for determining the position of the spinous process in radiography?

The student's course grade is based on scores for different parts of their proposal, IRB request, and two written examinations, comprised of multiple choice and short answer questions and problem solving situations.

Changes for future course offerings include developing a complete syllabus with all handouts for the students at the beginning of the course. With increased interest in registering for the course, more than one principal instructor will be needed if greater than 20 students register for the course at one time. This is in order to give personal attention to each student and the mini proposal. Before instructors are assigned to specific students during the course, interrater reliability studies must be done on the instructors' grading of the proposals and IRB forms. Interrater reliability assures that an instructor is grading the same as another.

All students enrolled in the professional curricula of nuclear medicine technology, radiography, diagnostic medical sonography, and radiation therapy technology are required to complete this course. Nuclear medicine technology students have an option to conduct their research during the following semester. After completing their nuclear medicine technology professional curriculum for board eligibility, students may elect to emphasize research activities during the additional year in the baccalaureate degree program.

The reliance on research for new discoveries and directions makes it important that all participants in the nuclear medicine arena know how to conduct research.

CONCLUSION

Success of the course can be measured by the following student comments: "This class made me really think about the 'legal' aspects of doing research that I never realized." "It gave me more insight as to what is required to initiate, conduct, and conclude a research project." Current follow-up for the course includes the interest shown the second semester in conducting research and displaying the results at an annual allied health research forum. Approximately one-third of the class entered projects in the forum this spring. Continued encouragement will hopefully see this number increase.

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