A UNIT OF RADIATION INSTRUCTION FOR THE PROFESSIONAL NURSING STUDENT

by

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ABSTRACT

This study dealt with the development of a unit of radiation nursing to be incorporated into the Medical-Surgical Nursing courses, as taught by the Faculty of Montana State College School of Nursing.

The purpose of this study was to prepare a unit course outline for the nursing student to apply the concepts of safe nursing care while meeting the needs of the patient receiving radiation therapy.

The overall objectives of this study were: that the nursing student develop (1) the ability to understand the interrelations of the fundamental principles of radiation and the basic concepts of inorganic chemistry, (2) a knowledge and understanding of radioisotopes as they are used in the hospital for diagnosis and therapy and (3) the ability to identify the important principles of nursing care for patients receiving radioisotope therapy. Twelve lesson plans were formulated within the framework of these objectives.

This study was conducted through the use of a documental method of research. The Tyler rationale, Bloom's taxonomy, and the Philosophy of Montana State College School of Nursing were employed to develop objectives, screen objectives, and select learning experiences.

CHAPTER I

INTRODUCTION

Origin of Problem

One of the greatest most far-reaching effects of this Atomic Age on human life has been its contribution to the rapid development of nuclear medicine. People have always lived and thrived in an environment of radioactivity. It is only their knowledge of it which has come to light in the last 65 years.

The door to this new era in scientific knowledge was unlocked in 1895 when Wilhelm Roentgen discovered the powerful invisible x-ray and in 1896 when Henri Becquerel discovered natural radioactivity. Two years later Marie and Pierre Curie isolated radium. Radiation medicine was advanced in 1934 when their daughter, Irene, and her husband, Frederick Joliet, discovered that stable atoms could be made unstable and developed the first artificially produced radioisotopes. March 1936, saw a human disease, leukemia, studied for the first time by an artificially produced radioisotope - radiophosphorus. Since then x-rays and radioisotopes have advanced the treatment and diagnosis of disease.

Katherine R. Nelson, Instructor in Cancer Nursing, Teachers College, Columbia University, defined radiation medicine, also known as radiotherapy or atomic medicine, by stating, "Radiation medicine is the treatment of disease, most frequently cancer, by means of x-ray and radioactive substances."[1]

[1] Katherine Nelson, "What is Radiation Medicine", Nursing World, Vol. 133, No. 4, April, 1959, p. 96.

Radiation medicine has progressed rapidly over the past few years and x-rays and radioactive isotopes are now widely used. Clinically, radioactive isotopes render two distinct services. Because of the unique affinity certain radioisotopes have for particular body tissues, they are important in the study and diagnosis of both normal and pathological processes. Also they have been used successfully as therapeutic agents.[2]

Today radioisotopes are produced in powerful atomic reactors. New uses are discovered daily in all branches of science. In medicine, radioisotopes can be administered directly into the system of the body or by a more remote method, teletherapy.

One of the greatest problems in working with radioactivity is that it cannot be seen or felt and it cannot be detected without the use of special instruments. The potential of the energy in radiotherapy is immense but so are the dangers inherent in its misuse. The nature of these dangers must be understood by nurses and accordingly unnecessary fears of radiation hazards dispelled.

Today radioactivity as a health hazard is a little-understood problem, yet nuclear power is here to stay and production and handling of radioactive items a major industrial item. For this reason radiation awareness is a must for anyone handling radioactive materials. Because no one, not even the expert, knows all there is to know about radiation, many have a lack of complete

[2]Patricia Burns and Helen Parker, "When Radioactive Iodine or Gold is Used," American Journal of Nursing, Vol. 56, No. 11, Nov. 1956, p. 1404.

information or an abundance of wrong information regarding this subject. Our most reliable knowledge today has come from actual experience compared and projected against radiation theory derived from human and animal experiments.[3]

Because of inherent dangers present in any radioactive material, the use of radioisotopic procedures can seldom be completely routine.[4] Only experienced personnel can be invested with the responsibility of the use of radioisotopes and a nurse who is to care for these patients should first develop background knowledge in this area.

In 1946, following World War II large amounts of radioisotopes were available to the medical profession and radiation medicine became a developing field. This did, and continues to present new problems for the professional nurse, who has to provide good nursing care and maintain adequate safety precautions for herself, other personnel, and the patients' visitors. She needs basic information on the subject of radioactivity, the radiations given off by radioactive isotopes, and the relations of these radiations to nursing.[5]

Peplau described nursing as follows:

> Nursing, as an applied science, develops its principles by interrelating ones from all other known sciences and applying

[3] L. J. Cherubin, "Minimizing Radiation Hazards", Chemical Engineering, June 27, 1960, p. 105.

[4] "The Radioisotope Service", Therapeutic Notes, June, 1958, p. 143.

[5] Nelson, op. cit., p. 96.

them to everyday nursing problems.[6]

If the professional nurse is to adhere to this definition of nursing, she must look into the area of radiation nursing and give attention to the many problems associated with the nursing care of patients undergoing radiation therapy. The nurse has the responsibility of maintaining awareness in the area of radiation nursing. She need not be a physicist or an expert but she must know new developments in the medical field. While it is very true that radiation medicine can be a complex subject and some practical and basic knowledge is required from other sciences, the nurse must seek out information which is essential in order to provide the best possible kind of nursing care for the patient.

A professional nurse is qualified to nurse any ill person back to health.[7] However, is the average nurse well informed on nursing care for patients receiving radiotherapy? It is true that this type of learning does require some effort on the part of the nurse. However, it was the feeling of the investigator that radiation medicine could be made fairly simple for the nurse and practical information could provide her with greater understanding, allay her unnecessary fears, and contribute toward better nursing.

[6]Hildegard Peplau, Interpersonal Relations in Nursing. New York: G. P. Putman's Sons, 1952, p. 14.

[7]Nelson, op. cit., p. 96.

Review of Literature

A review of literature showed a surprisingly small amount of enlightening material available for the professional nurse on radiation medicine. Several writings were available giving specific detail of one particular type therapy, a specific nursing problem, or a general picture of radiation medicine. Studies presenting a thorough and complete combination of this material could not be found.

A forward step was taken by the U. S. Naval Medical School, National Naval Medical Center, Bethesda, Maryland, when a 4 month postgraduate course in nuclear nursing for the professional nurse was instituted in 1956.[8] However, for the professional nurse not wishing to make a specialty of this field, but desiring to be informed and understanding in this area of nursing, minimal comprehensive literature was available.

Statement of the problem

Can the available information on radiation medicine be collected and organized into a unit for presentation to nursing students; could this unit be included in a course outline for the student designed to review basic chemistry principles, and relate them to the study of radiotherapy and the principles of nursing care?

[8]The Nuclear Nursing Program, U. S. Medical School, National Naval Medical Center, Bethesda, Maryland.

Assumptions of the Investigator

This technical paper on radiation and radioisotope therapy was written to apply to the nursing student. It presents a unit in a course outline related to this information and applicable for instruction of sophomore nursing students during their clinical instruction.

This paper was written for the sophomore nursing student during her clinical instruction for two reasons. First, this group of students, who had recently completed the inorganic chemistry on the college campus, should have some background on which to base this information. With a brief chemistry review it seemed likely that these students would be ready to enter into a new learning area with less adjustment than the more advanced nursing students who had not studied chemistry for a longer period of time.

Secondly, with the rapid development of nuclear medicine, nursing students were exposed to seeing and hearing about radiation medicine soon after their entrance into clinical nursing courses. It seemed that no better time could be found to present learning experiences in this area of nursing than during the sophomore year. Students would begin building a basic foundation on which to base further developments in this area as medical science progressed. They would also have a continually growing understanding of radiation medicine as they progressed through different levels of clinical instruction and gained actual experience in caring

for more patients receiving radiation therapy.

Statement of Overall Objectives

That the nursing student develop:

1. The ability to understand the interrelations of the fundamental principles of radiation and the basic concepts of inorganic chemistry.
2. A knowledge and understanding of radioisotopes as they are used in the hospital for diagnosis and therapy.
3. The ability to identify the important principles of nursing care for patients receiving radioisotope therapy.

Limitations of the Study

Although a great deal is presently known about the field of radiation, there remains a great deal more that scientists are striving to learn. New discoveries are continually being sought and the increasing importance of the atomic energy field is leading to a growing exploration in this area. New findings in this field can occur at any time. It is likely that even though this study is based on the most recent information available, many of the facts presented are already outdated.

Experts have expressed widely differing opinions as to problems and possible consequences of irradiation. In this presentation the investigator attempted to present those opinions agreed on by the majority of specialists in this field.

Organization of the Remainder of the Study

The remainder of this study was arranged into three chapters.

Chapter II explains the design for this study including a documental method of research, an analysis of the objectives, and a discussion of teaching methods. Chapter III presents the course outline including objectives, assignments, learning experiences and content. Chapter IV contains a summary and recommendations.

CHAPTER II

DESIGN OF THE STUDY

Overview of the Study

Having selected the problem area and limited the study to preparation of unit lesson plans for sophomore nursing students during their period of clinical instruction, it became necessary to: (1) gather data pertinent to meeting the objectives; (2) determine teaching-learning methods most effective in presenting this material; and (3) prepare lesson plans correlating the preceding two steps.

Twelve pharmaceutical houses were contacted for the latest information on radioactive isotopes in medicine. Answers were received from all twelve companies.

The Atomic Energy Commission and the American Cancer Society sent material on radiation and radio-isotopes. A request for material on radio-therapy from research and radiation departments of five hospitals brought information on procedures and precautions used in these institutions.

Chemistry textbooks, medical and nursing journals, and other medical science and atomic energy literature rounded out the source material used to formulate this paper.

Development of Education Objectives

Education is a process of changing the behavior patterns of the individual. The objectives of a course indicate the changes in behavior that an educational institution, through its

faculty and resources, endeavors to bring about in the learner.[9] Clearly defined objectives become the criteria for guiding all other activities of curriculum planning; selection of materials, outline of content, and development of procedures.[10]

Four factors were considered in developing and selecting objectives. They were:

1. The content of the philosophy for the Montana State College School of Nursing and its use in screening objectives.
2. The selection and organization of objectives in accordance with sound principles of learning.
3. The formulation of a two-dimensional behavior-content chart and its use in stating the objectives.
4. A taxonomy of educational objectives to gain a perspective of desired behaviors from specific objectives.

Importance of the Philosophy

There was a need to incorporate learning experiences in radiation nursing into the curriculum if the beliefs and values stated in the philosophy of the Montana State College School of Nursing were to be maintained. The philosophy states:

> The course work in this curriculum offers all types of nursing and related subject matter (biological, physical, and social science, medical, psychiatric, and public health principles, skills, in interpersonal and group relations communications) and combines these into knowledge of current

[9] Ralph W. Tyler, Basic Principles of Curriculum and Instruction, Chicago: The University of Chicago Press, 1959, p. 4.

[10] Ibid, p. 3.

> nursing principles and practices. Through use and satisfaction in achievement is established a pattern of educational self-discipline, and opportunity exists for students to become participating, well-integrated, and informed members of society.[11]

This portion of the philosophy emphasized the importance of integrating and using current nursing practices and being informed with those sciences which correlate to the current trends in nursing.

As the philosophy further stated:

> The faculty believes that professional nursing involves an ascending order of knowledge and intellectual skills and abilities in giving nursing care, in participation as a member of the health team, and in improving the quality of health practices and services for herslef, the family, and the community. Therefore, the curriculum is designed as a continuum of professional education.[12]

This again emphasized the importance of integrating and expanding the nursing student's skills. The course must relate subject matter and learning experiences and provide a sequence and continuity that is meaningful to the student.

In forming overall objectives for this study the investigator first screened them through five main points stated in the philosophy of the Montana State College School of Nursing. This eliminated contradictory or unimportant objectives. The method of screening objectives through the philosophy is explained, using the first overall objective as an example.

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[11] Philosophy, Montana State College School of Nursing, October, 1960.

[12] Ibid.

The first overall objective for this study was: to develop ability to understand the interrelations of the fundamental principles of radiation and the basic concepts of inorganic chemistry. The first point from the philosophy used for screening this objective was: does the accomplishment of this objective lead toward a participating well-integrated and informed citizen? The objective screened through this area because the investigator planned to present material on radiation and basic chemistry principles which was of timely interest and importance to nurses in their profession and in their participation in society. Knowledge of this material enabled the professional nurse to be informed and understand a current day subject which extended beyond the field of medicine.

A second point from the philosophy used in screening was: does the accomplishment of the objective lead toward a competent professional nurse and increase skill in patient care? The objective screened through this question satisfactorily because it laid the foundation for the nursing care principles and precautions which helped increase the nurse's skill and competency.

A third point was: is the accomplishment of the objective pertinent to nursing practices? The first objective was screened through this question. Radiation nursing is a field of nursing which is growing in importance. To develop an understanding of this field, the nurse had to first know the fundamental principles of radiation as they were presented in the first objective.

A fourth point was: does the accomplishment of this objective involve an ascending order of knowledge, skills and abilities? The first objective began with a review of basic chemistry principles and progressed to fundamental concepts of radiation applicable to the nursing student in a clinical situation. This called for an ascending order of knowledge and the development of skills and abilities as the students began to use the problem solving method in situational cases.

The fifth point was: does the accomplishment of the objective help the nurse improve the quality of health practice and services to herself, the family and the community? The first objective presented information basic to understanding the principles of protection and safe nursing care. These principles were necessary to improve the quality of health practices and services received by the nurse, the patient, his visitors and the community.

The remaining two overall objectives were:

1. A knowledge and understanding of radioisotopes as they are used in the hospital for diagnosis and therapy.

2. The ability to identify the important principles of nursing care for patients receiving radioisotope therapy.

These objectives were screened through five main points taken from the philosophy in the same manner as the screening of the first objective was described.

The following table showed the three overall objectives to be in harmony with the main points of the philosophy. In this screen

when the inter-sections were marked with X's it was implied that the objective applied to the particular statement through which it was screened.

Philosophy of Montana State College School of Nursing	Objectives No. 1	No. 2	No. 3
Leads toward a well-integrated citizen	X	X	X
Leads toward a competent professional nurse and increases skill in patient care	X	X	X
Is pertinent to nursing practices	X	X	X
Ascending order of skills	X	X	X
Helps to improve quality of health practice and services	X	X	X

Tyler stated the following concerning the use of the philosophy as a screen for objectives:

> For a statement of philosophy to serve most helpfully as a set of standards or a screen in selecting objectives it needs to be stated clearly and for the main points the implications for educational objectives may need to be spelled out. Such a clear and analytical statement can then be used by examining every proposed objective and noting whether the objective is in opposition or is unrelated to any of these points. Those in harmony with the philosophy will be identified as important objectives.[13]

[13]Tyler, op. cit., p. 24.

Importance of the Psychology of Learning as a Screen for Objectives

The second screen through which the overall objectives were passed included criteria formed by the psychology of learning. At the lowest extreme a knowledge of the psychology of learning enabled one to distinguish changes in behavior that could or could not be expected to result from a learning process. At a higher level, knowledge of psychology of learning enabled the individual to distinguish goals that were feasible from those that were likely to take a long time or were almost unattainable at the age level contemplated.[14] Other purposes of the psychology of learning were:

1. To determine grade placement of objectives.
2. To identify conditions which are requisite for learning.[15]

The psychology of learning not only included specific and definite findings but also involved a unified formulation of a theory of learning which helped to outline the nature of the learning process, how it takes place, under what conditions, what sort of mechanisms operate and the like.[16]

The nine principles of learning compiled from people involved in education make up the major concepts of the psychology of learning. These nine statements were the second screen for the overall objectives. A narrative description of the first overall objective

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[14] Ibid., pp. 24-25.

[15] Loc. cit.

[16] Ibid., p. 27.

being screened is presented. The remaining two overall objectives were screened in the same manner.

The first overall objective for this study was: to develop ability to understand the interrelations of the fundamental principles of radiation and the basic concepts of inorganic chemistry.

Principles of Learning	Learning Screen
1. Learning takes place more effectively when the student is ready to learn.	1. The objective was designed to begin at a level of chemistry with which the students were already familiar. The course content was to be presented to students soon after completion of basic chemistry courses.
2. Individual differences must be considered if effective learning is to take place.	2. The course content began with fundamental chemistry principles, allowing each student to begin with basic background knowledge. Posed questions and situational problems pointed out individual differences as the course progressed.
3. Motivation is essential for learning.	3. In discussing radiation nursing with students, feelings of interest, curiosity, or fear were noted. Almost all students had some attitude about this area of nursing which in the opinion of the investigator could become motivation if the other principles of learning were observed.
4. What the student learns in any given situation depends on what she perceives.	4. Because each student looks at things differently, an attempt was made to organize material in two or more different ways.
5. Learning takes place more effectively where the student derives feelings of satisfaction.	5. The problem solving method presented opportunity for the student to see results of working with material discussed in class.

Principles of Learning	Learning Screen
6. Recognition of similarities and dissimilarities between past experience and the present situation facilitates the transfer of learning.	6. The student had opportunity to correlate past learning experience in chemistry to new experiences in chemistry and radiation.
7. A student learns what she actually uses.	7. Situational problems and posed questions gave students opportunity to practice what they had discussed.
8. Interpersonal relationships are important in motivation and in determining the kind of social, emotional, and intellectual behavior which emerges from the learning situation.	8. Lessons were planned to stimulate class discussion and present situational problems to be solved by the group.
9. Evaluation by both the student and the teacher is essential for determining whether desirable changes in behavior are actually taking place.[17]	9. Evaluation could be examined according to changes in behavior as observed by class discussion and problem-solving ability.

[17] Ole Sand, Curriculum Study in Basic Nursing Education, New York: G. P. Putman's Sons, 1955, pp. 54-60.

Illustration of Objectives Using a Two-dimensional Chart

Content Aspect of the Objective	Behavioral Aspects of the Objectives				
	Acquisition of Information	Understanding Important Facts and Principles	Ability to Interpret Data	Ability to Apply Principles	Familiarity With Dependable Sources of Information
A. Fundamental Principles of Radiation					
1. Relationship with basic concepts of inorganic chemistry	X	X	X	X	X
B. Use of radioisotopes					
1. For diagnosis	X	X	X	X	X
2. For therapy	X	X	X	X	X
C. Principles of Nursing Care with Radioisotope Therapy					
1. Individual Nursing Care Plan	X	X	X	X	X

The preceding chart was based on a two-dimensional chart developed by Tyler.[18] From this were derived suggestions for behavioral aspects it was felt were to be included in the objectives. The content aspect was developed from the area in which the behavioral aspects were to operate.

Tyler stated the following:

> It can safely be concluded that a statement of objectives clear enough to be used in guiding the selection of learning experiences and in planning instruction will indicate both the kind of behavior to be developed in the student and the area of content or of life in which the behavior is to be applied.[19]

A graphic two-dimensional chart helped to express objectives concisely and clearly. The purpose was not to see if the objectives were appropriate for it was felt the preceding steps had identified and screened the objectives.

Importance of Educational Taxonomy

Bloom stated there are three domains in which learning evidenced by behavior changes may occur: (1) cognitive, (2) affective, and (3) psychomotor.

The cognitive changes are concerned with the recall or recognition of knowledge and the development of intellectual skills and ability to think. This is the domain in which most of the work in curriculum development has taken place.[20]

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[18] Tyler, op. cit., p. 32.

[19] Ibid., p. 30.

[20] Benjamin S. Bloom, Taxonomy of Educational Objectives, New York: Longmans, Green, and Co., 1956, p. 7.

The writer used the taxonomy for this study to (1) help specify objectives so that planning of learning experiences was facilitated and (2) help gain a perspective on the emphasis to be given to certain behaviors from the particular set of educational plans which were developing.

Classification of Objectives

1. Objective: The ability to understand the interrelations of the fundamental principles of radiation and the basic concepts of inorganic chemistry.

1.32 Knowledge of theories and structures.

This classification included a knowledge of principles and generalizations together with their interrelations which presented a clear, rounded, and systematic view of the problem or field. Although in the objective the work "understanding" was used, it was felt this category covered the meaning of the word as it was intended. The students working toward this objective were to be sophomore nursing students. The behavior expected from these students emphasized the ability to remember and recall material, as well as relate this material when it was posed in a different form than in the original learning situation.

2. Objective: A knowledge and understanding of radio-isotopes as they are used in the hospital for diagnosis and therapy.

2.20 Interpretation

The emphasis of this objective fell on the understanding aspect more than the knowledge category. It called for comprehension which

involved understanding because the professional nurse had to interpret her knowledge and understanding of radioisotopes to patients and co-workers in order to give safe nursing care. This category explained and summarized the communication and required that the students take a new view of the material presented. In doing this the student had to comprehend the relationship between the various radioisotopes and then develop an overall understanding of radioisotopes as a group of drugs used in therapy and diagnosis. The interpretation of this material would be facilitated if the student related it to the chemistry principles previously learned. Competence should have developed in selecting essential portions of the material presented from those that were less essential.

3. Objective: The ability to identify the important principles of nursing care for patients receiving radioisotope therapy.

2.00 Comprehension

This category represented the lowest level of understanding. In meeting this objective it was hoped that the nursing students in their year of clinical instruction had developed an understanding of the important principles of nursing care and were able to make some use of them in a clinical situation. As they gained ability and experience it seemed that they would have a more complete understanding and that they would see the fullest implication of this material.

Plan for Learning Experiences

As the objectives were defined to the point where they began to guide action, the importance of defining specific learning experiences arose. The objectives would be attained through the students' learning experiences.

In planning learning experiences an attempt was made to include teaching methods which required student participation. This was based on Tyler's rationale that "learning takes place through the active behavior or the student; it is what he does, not what the teacher does."[21]

Tyler pointed out that in order for educational experiences to produce a cumulative effect, they must be organized to reinforce each other.[22] Organization of learning experiences was necessary in order that they did not become isolated incidents. Vertical and horizontal relationships were provided in the learning experiences. In a verticle relationship each successive experience builds upon the preceding one.[23] In a horizontal relationship the experiences help the student get a unified view and to unify her behavior in relation to the situation dealt with.[24]

The Montana State College nursing students studied inorganic

[21]Tyler, op. cit., p. 41

[22]Ibid., p. 54

[23]Ibid., p. 55

[24]Loc. cit.

chemistry on campus before receiving instruction in clinical nursing. There they came in contact with many chemistry terms which were repeated in mastering the first objective. It was hoped that the students were able to relate this previous learning experience to learning experiences planned in meeting the first objective. This relating of learning experiences was designed to carry on as they moved into the remaining two objectives of the unit. The material was organized so that the students were continually building on previous experiences.

It was the opinion of the investigator that the problem solving method stimulated a desirable type of behavior, in that students were led to do inductive, deductive, and logical thinking. Problem solving is characterized by careful consideration and evaluation of data, and usually calls upon past experience and also examination of source material before a sound conclusion is reached. This method appeared to be an effective means of meeting the three objectives.

The first overall objective was: to develop ability to understand the interrelations of the fundamental principles of radiation and the basic concepts of inorganic chemistry. This objective required a learning experience focused toward acquiring information. The problem solving method was believed valuable in this type of experience. Tyler stated "When information is acquired as a part of problem solving, the use of information and the reasons for

obtaining it are clear."[25]

In presenting this information the following suggestions were helpful:

1. The material must be selected so that only important information that is frequently used and worthy of remembering is included. This is to help prevent the rapid rate of forgetting most students show and to prevent memorization without understanding.

2. Material should be organized so that it can be presented in two or more ways. This allows the student to see different situations in which the same material can be used.

3. Students should be given an opportunity to develop familiarity with accurate and recent sources of information. This can be accomplished if within this learning experience some type of problem solving is included.[26]

The principles derived from the psychology of learning were sound teaching guides. In determining teaching methods it was particularly important to keep these nine principles in mind. The investigator felt it especially important to give attention to the principle which recognized that the student learned what she actually used.

Because of the many problems the campus students vocalized concerning chemistry, the writer doubted the actual understanding the average student had in this area. For this reason the outline for the first overall objective indicated use of a lecture, supple- by group discussion. Participation was activated through pre-

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[25] Ibid., p. 47.

[26] Ibid., p. 46-48.

sentation of posed questions requiring answers which reflected understanding of principles being presented. This gave students an opportunity to identify and apply principles from a previous course that applied in a present situational problem. As used here, the lecture was a learning technique compatible with the problem solving method.

In using the problem solving method care had to be taken that the problem was neither too difficult nor too easy for the group to solve and that it was of interest to them; it proceeded from the simple to the complex. Leahy and Bell felt the problem solving approach could be employed in three ways: it could be an independent piece of work by an individual student, it could be a joint undertaking by student and teacher, or it could be done by the instructor to demonstrate how problem solving was carried out.[27] In this study the problem solving method was accomplished by presentation of case material and situations relating to the specific material presented in the classroom. This called for discussion within the group and guidance from the instructor to keep the class directed on the topic being developed.

Carefully planned observations in the radioisotope room, the radiation department and on the ward gave the students an opportunity to gain further understanding of what was discussed in the classroom.

[27]Kathleen M. Leahy and Aileen Tuttle Bell, Teaching Methods in Public Health Nursing, Philadelphia: W. B. Saunders Co., 1952, p. 65.

In these situations they saw the principles of nursing care and the safety measures that they had heard about being carried out in actual practice. Planned observations were planned to be preceded by a discussion of the points to be identified and followed by a discussion with opportunity for the students to ask questions.

CHAPTER III

PRESENTATION OF COURSE CONTENT

OVERVIEW:

This unit of radiation nursing for the care of Medical-Surgical patients will serve as a basic preparatory course, helping to prepare the student to apply the concepts of safe nursing care while meeting the needs of the patient receiving radiation therapy. Concurrently, in lessons one through four, students review concepts of inorganic chemistry which relate to fundamental principles of radiation. This includes information concerned with atomic structure and atomic energy as they are related to the production of radioisotopes; the characteristics of alpha, beta and gamma rays as they are found in radioactive materials; the nature of radioactive fallout; the nature of x-rays, radium, and radon; and measurements and units of radiation. Lessons five through eight acquaint the student with the use of radioisotopes in diagnosis and therapy. They are introduced to the radiation department and radioisotope room in the hospital. Students gain familiarity with the specific radioisotopes; their uses, dangers and side effects. Lessons nine through twelve deal with principles of nursing care precautions, general nursing care principles and stages and supportive care of radiation sickness.

Some of the teaching methods used are: observations, case material, classroom discussion, situational problems, and sharing experiences. The problem solving approach is used to encourage active learning and to produce more meaningful learning.

Overall Objective: to be achieved in Lessons 1 through 4

The ability to understand the interrelation of the fundamental principles of radiation and the basic concepts of inorganic chemistry.

Overall Objective: to be achieved in Lessons 5 through 8

A knowledge and understanding of radioisotopes as they are used in the hospital for diagnosis and therapy.

Overall Objective: to be achieved in Lessons 9 through 12

The ability to identify the important principles of nursing care for patients receiving radioisotope therapy.

OBJECTIVES & ASSIGNMENTS	EXP. AND ACT. INCLUDING CONTENT

Assignment for Lesson 1:

Read sections from an inorganic chemistry textbook which include the structure of the atom and those definitions listed under #3 of Experiences and Activities.

To develop awareness of the need for the nurse to have an understanding of elementary inorganic chemistry as a basis for this unit of study.

To review basic principles of chemistry.

1. Distributing and reviewing course outline and examining the scope of study.
2. Listening to introductory lecture on and discussing the importance of chemistry in this unit.
3. Developing a useable vocabulary of the following chemistry terms:
   a. atoms
   b. elements
   c. molecules
   d. neutrons
   e. electrons
   f. protons
   g. atomic number
   h. atomic weight
   i. isotopes
4. Discussing the structure of the atom and ionization.

Assignment for Lesson 2:

1. Read about the history of the development of the atomic era. Note contributions of:
   1. Henri Becquerel
   2. Wilhelm Roentgen
   3. Marie and Pierre Curie

   Note discussion of elements:
   1. Uranium
   2. Radium

Crucial Areas for Lesson 1

1. The importance of chemistry in radiation nursing.
2. Understand and know chemistry terminology.

Sources:

1. Routh, Joseph I. 20th Century Chemistry, pp. 48-50, 61-2.

OBJECTIVES & ASSIGNMENTS	EXP. AND ACT. INCLUDING CONTENT
Assignment for Lesson 2: Define Radioactivity 2. Read an explanation of atomic energy. 3. Write a paragraph in your own words on what you understand by the term, atomic energy.	Sources: 2. Bogart, L. Jean. Fundamentals of Chemistry, pp. 226-8, 242-7. 3. Biddle, L. C. and V. W. Floutz. Chemistry in Health and Disease, pp. 233-8, 244-6.

Description of Learning Experiences for Lesson Plan I

1. The first learning experience would include:

   a. A review of the overall objectives for the unit
   b. A discussion of the scope of this study

This unit of study attempted to answer questions on radiation and radioactivity which concern the nursing student. Basic to an understanding of this field, was an understanding of the atom and its structure. Thus the first lesson dealt primarily with the atom and related subjects. From here this unit proceeded to the subject of radioactivity and radiation. These were discussed in meeting the first overall objective.

For the second overall objective the emphasis was on radioisotopes, their use, those most frequently used, and dangers or complications produced by their use.

The third overall objective was concerned with nursing care.

This area studied precautions and their principles, principles of nursing care, and also included radiation sickness.

2. The second learning experience might include factors presented in the following paragraphs.

According to Biddle and Floutz, "An understanding of Chemistry will make a better nurse....Herein lies the superiority of the professional over the practical nurse."[28]

This quote stresses that chemistry is a subject of prime import which holds the key to many life processes and transformations that are seen in any branch of nursing practice. This is true in the field of radiation.

Without understanding and knowledge of atoms, elements, the electron theory and other basic principles and concepts of chemistry, the nurse cannot fully appreciate the importance of radioactivity, the radiations given off by radioactive isotopes and the relations of these radioisotopes to nursing. Radiotherapy is now widely used in most hospitals. It is improbable that any nursing students today won't have experience with radiation therapy. For this reason knowledge in this field is desirable.

Further discussion should point out that radioactivity is not new nor does its mere presence present a hazard. However, the amount and manner in which it is used does. Potassium, an element in foods we eat and drink, contains small amounts of radioactivity. Walls of houses may have radioactive substances. Cosmic rays reach us daily from outer space. This helps one realize that radioactivity in itself is not something to fear. However, its growing importance and increased usage can easily make this a danger unless it is managed by the nurse who knows the basic concepts and follows definite safety precautions when necessary.

At this point it would appear advisable to open the discussion for questions or opinions the group might have. It might be interesting to note the understanding the class appears to have of radioactivity at the beginning of this unit as compared with

[28]Harry C. Biddle and Vaughn W. Floutz, Chemistry in Health and Disease, Philadelphia, F. A. Davis Company, 1960, p. 2.

their comprehension of this term at the end of their period of study.

3. The third learning experience calls for discussion and defining of the previously assigned terms.

a. Atom. This is the smallest and ordinarily indivisable part of an element, except in the case of radioactive elements. All atoms of the same element are alike in their chemical properties.

b. Element. This is the simplest form of matter. It cannot be broken down by any chemical means into simpler substances and it cannot be formed by the union of simpler substances. Hydrogen is the simplest element.

c. Molecule. This is the smallest particle of a substance that can exist and still retain the properties of that substance. There can be a molecule of water and if this is further divided one has the two atoms of hydrogen and one atom of oxygen of which a water molecule is constructed. Molecules can be the same particles as atoms, e.g. atoms of iron are identical with molecules of iron. Molecules are usually composed of atoms and larger than atoms.

d. Neutrons. This is an electrically neutral part of the nucleus of the atom.

e. Protons. This is a positive charge contained within the nucleus.

f. Electron. This is a particle of negative electricity outside the nucleus of the atoms

g. Atomic number. This is an electric charge which corresponds to the number of free protons in the nucleus or electrons revolving outside the nucleus. Hydrogen has an atomic number of one because it has one free proton in the nucleus.

h. Atomic weight. This can be figured by totaling the number of protons and neutrons found in the nucleus of an atom. It shows the ratio of the weight of an atom of an element to 1/16 the weight of an oxygen atom. Oxygen is a standard and equals 16. Hydrogen is 1.008, commonly called one.

The nucleus (neutrons and protons) of the atom is heavier than the surrounding electrons even though it is smaller than the electrons. It is said that if a human being could be

compressed down into his nuclear density he would occupy the space of a pinhead. One cc. of nuclear material weighs about 100,000,000 tons.[29]

i. Isotopes. Atoms of the same element may have different numbers of neutrons in the nucleus. They behave alike chemically because they have the same number and arrangement of protons and electrons, but the atomic weight differs because the number of neutrons changes. The atomic number remains the same.

4. In discussing the structure of the atom the following points are important:

a. Each atom has a compact nucleus, made up of protons and neutrons, and is surrounded by free electrons revolving about it.

b. There is always an equal number of protons and electrons so that the atom itself is electrically neutral.

c. Electrons are held in orbit by the positive attraction of the nuclei and are arranged in "shells" which have a definite pattern.

d. Two electrons complete the innermost ring, eight the second, and 8 to 18 the third and so on up to seven rings.

e. If the outer ring has its full complement of electrons the element will be chemically inert.

f. If an atom is not chemically inert, then a certain number of electrons must be lost, gained, or shared in order to secure a stable outer share of electrons.

This last point ties in closely with ionization. Ionization of an atom occurs when an electron is removed from its outermost orbit, thus rendering it electrically positive. When this removed electron attahces itself to the outer orbit of a neutral atom it makes it electrically negative. Ionization of an atom is important because it is through ionization that atomic particles and electromagnetic waves can exert their biological and therapeutic effects.

[29] A. J. Delario, Roentgen, Radium and Radioisotope Therapy, Philadelphia: Lea & Febiger, 1953, p. 8.

All types of radiation have the ability to alter the chemical nature of body cells by dislodging electrons from atoms, e.g. producing ionization.

The body is able to tolerate a low level of radiation with no significant ill effects. Large doses, however, may result in considerable ionization and damage or destroy many body cells, disrupt the normal blood picture. It is against the hazards from such larger doses that safety precautions are necessary.

OBJECTIVES & ASSIGNMENTS	EXP. AND ACT. INCLUDING CONTENT
Lesson 2 To become acquainted with the history of the development of radiation and radioactivity. To develop an understanding of atomic energy. Assignment for Lesson 3: 1. Define the following terms to be handed in and discussed in class: a. half-life b. alpha, beta, gamma rays c. radon d. x-rays e. artificial radioactivity f. transmutation	Lesson 2 1. Presenting for discussion the contributions made by: Wilhelm Roentgen Henri Becquerel Marie and Pierre Curie 2. Defining and discussing radioactivity. 3. Discussing the elements; uranium and radium. 4. Reviewing the structure of the atom and clarifying through discussion its relationship to atomic energy. 5. Sharing ideas to form a definition of atomic energy for the group. Crucial Areas for Lesson 2 Developments leading to the use of radiation in medicine.

OBJECTIVES & ASSIGNMENTS	EXP. AND ACT. INCLUDING CONTENT
Assignment for Lesson 3:	Crucial Areas for Lesson 2:
2. Answer the following questions: a. What radiation from radium is effective in its therapeutic applications and why? b. Why in many cases can x-ray treatment be substituted for radium treatment? c. How is radon obtained and in what way may it be used? d. Differentiate between the terms isotope and radioisotope. e. List five radioactive elements. What information tells you these are radioactive elements?	Understand the terms atomic energy and radioactivity. Sources: 1. Bogart, L. Jean. pp. 227-34, 237-8. 2. Biddle and Floutz. pp. 231-8, 240-3. 3. Routh, Joseph I. pp. 50-9. 4. Berry, Edna C. and Mary L. Kohn, Introduction to Operating-Room Technique, pp. 87-91. Suggested Reading: Eva Curie, Madame Curie, New York: Garden City Publishing Co., 1955.

Description of Learning Experiences for Lesson Plan 2

The material included in the learning experiences for this lesson had been previously assigned, thus providing opportunity for these learning experiences to be carried out through group discussion. The following information may be helpful for the instructor guiding the discussion.

1. Roentgen. Because the nature of the rays Roentgen discovered were not understood, they were called x-rays. Within weeks after his discovery was announced physicians were using them for investigation of broken bones and in diagnosis.

Becquerel. He discovered that a piece of uranium ore he accidentally left on a photographic plate affected the plate very much as x-rays did. Until this time no one suspected that an element could decompose spontaneously with emission of rays. This property, called radioactivity, is discussed in the next learning experience.

Marie and Pierre Curie. This couple investigated all the known elements for radioactivity. In their investigation they found that pitchblende, an ore which contained uranium, exhibited the elements in this ore and tested each for radioactivity. A new element, radium, was discovered from this ore in 1893. Radium was not isolated as a pure metal until 1910, four years after the death of Pierre Curie.

Marie Curie died at the age of 67 of aplastic pernicious anemia brought on by a long accumulation of radiation.

2. In discussing and defining terms such as radioactivity, atomic energy and others throughout the following lesson plans, the members of the class should be encouraged to participate. The instructor can then proceed to incorportate ideas and opinions expressed into understandinable and useable explanations.

Radioactivity is a property of the elements with the heavier atoms and higher atomic numbers, e.g. those over 82. An example is radium with 88 protons and 138 neutrons. An element such as radium has a disproportion in the neutron-proton ratio. There are over one and one-half times as many neutrons as protons. This disproportion yields instability of the nucleus. In an attempt to re-establish stability there are, from time to time, small explosions in the nucleus of the atom and various fragments are shot out at high speed. This nuclear disintegration is given off in the form of radiations.

3. Radium is obtained from various ores containing uranium. Two of the best known of these ores are pitchblende, and carnotite. In the United States the best source of radium is carnotite and this is in the Rocky Mountain area.

Radium is 1,000,000 times more radioactive than uranium.[30]
"One ton of carnotite contains about 10 pounds of uranium and one-third of a milligram of radium."[31]

Uranium was of little importance before 1942. It then became one of the most important quantities. It had been discovered that it could be made a source of nuclear energy for warfare.

4. To understand the principle behind atomic energy, the student must refer again to the structure of the atom. The energy of an ordinary chemical reaction, such as the explosion of gunpowder, involves the electrons around the nucleus of the atom. Atomic energy involves the nucleus itself. It was not until scientists discovered how to break the nucleus that this energy was made available for use. It was first used for destructive purposes in the atomic bomb.

5. Atomic Energy. Since the protons of the nucleus are positively charged, and since like electrical charges repel each other, it must require a great deal of energy to bring protons as close to each other as they apparently are in the nucleus of the atom. Since energy cannot be destroyed, it is released if the protons are separated from each other. Therefore by breaking the nucleus into the particles of which it is made, nuclear or atomic energy is released. The release of the atomic energy produces invisible but powerful radiations.
This is important to the medical profession because it is through the breaking of the nucleus of an atom that radioisotopes have become available.

[30] Joseph I. Routh, 20th Century Chemistry, Philadelphia: W. B. Saunders Company, 1958, p. 49.

[31] Delario, op. cit., p. 22.

OBJECTIVES & ASSIGNMENTS	EXP. AND ACT. INCLUDING CONTENT
Lesson 3 To develop understanding of fundamental principles of behavior patterns of radioactive materials and x-rays.	Lesson 3 1. Discussing the terms and questions previously assigned for this lesson. 2. Listening to lecture on, discussing and asking questions on radioactive fallout including: a. What is fallout? b. Who is affected by fallout? c. Is exposure to radiation new? d. An example of a radioactive fallout incident.
Assignment for Lesson 4 Answer the following questions: 1. List three natural sources of radiation we are exposed to through our environment. 2. List three sources of artificial radioactivity we are exposed to through our environment. 3. Distinguish between a physical half and a biological half-life. 4. What is the expected half-life of the Cobalt-60 therapy unit at Billings Deaconess Hospital?	Crucial Areas for Lesson 3 1. Understand and know terminology. 2. Knowledge of nature of radioactive fallout.

OBJECTIVES & ASSIGNMENTS	EXP. AND ACT. INCLUDING CONTENT

Assignment for Lesson 4

Read:

1. Quimby, Edith H. Safe Handling of Radioactive Isotopes in Medical Practice, pp. 8-11, 26-8.

Suggested Reading:

1. Fowler, John M. Fallout, New York: Basic Books Inc., 1960, 213 pp.

2. Lapp, Ralph E. The Voyage of the Lucky Dragon, New York: Harper and Brothers, 1957, 200 pp.

3. Hersey, John. Hiroshima, New York: Alfred A. Knopj. 1946, 111 pp.

Description of Learning Experiences for Lesson Plan 3

1. The first learning experience calls for discussion of the previously assigned terms.

a. Half-life. This term refers to the rate at which the atoms of a radioactive substance give off their rays until their energy is so spent that for practical purposes they are no longer radioactive. Each radioactive substance has its own particular rate of decay varying from a few hours or less to thousands of years. Technically when the term half-life is used it refers to the physical half-life of an isotope.

The biological half-life refers to the average length of stay of the radioactive substance in the body. This differs from the physical half-life because it is influenced by body metabolism and rate of excretion.

b. Alpha rays. These particles do not travel far and can be stopped by as thin a substance as a peice of paper. They present little external hazard to the nurse. They can present a problem if they enter the body through breaks in the skin, inhalation, contamination, or ingestion through foods or on hands.

c. Beta rays. These particles may travel from one to 30 feet in the air but can only penetrate a half-inch or so of unbroken tissue. Externally, metal shields or distance will protect people from these rays. If ingestion occurs they are dangerous for about two centimeters.

d. Gamma rays. These rays are like hard voltage x-rays. They have about 10,000 times the penetrating power of alpha particles and require about two inches of lead or 12 inches of iron to screen them out. Most nursing care precautions are concerned with beta and gamma rays.

e. Radon. This is a gas given off as radium decays. It is captured inside fine gold wires which have holes in them like a hypodermic needle. The wires are then cut up into tiny pieces like the point of a lead pencil. These pieces are gold seeds and are implanted in tumor tissue. The half-life of radon is four days. By the end of a month the seeds are considered dead and never removed.

f. X-rays. These rays have very short wave lengths enabling them to pass through many substances, such as flesh, which are opaque to ordinary light. More dense objects such as bones and metals largely stop the radiation and in this way produce shadows.

Recent x-ray tubes can operate under very high potentials, frequently greater than 10,000 volts. These x-rays are referred to as hard rays or supervoltage.

g. Artificial radioactivity. This refers primarily to the artificially produced radioisotopes. It was discovered by Marie Curie's daughter, Irene, and her husband that stable atoms could be made unstable by bombarding them with certain radiations. The isotope then has a short lived activity and can be used in diagnosis and therapy.

h. Transmutation. As naturally radioactive elements disintegrate, they are transformed into other radioactive elements or isotopes. Uranium transmutes into several elements before it finally becomes a stable isotope of lead.

The questions might be answered as follows:

a. The gamma rays are particularly effective in treating cancer. They are capable of deep penetration and act on this type of tissue more readily than healthy tissue.

b. The most powerful rays of x-rays resemble gamma rays and frequently offer a simpler method of treatment.

c. This is answered under the discussion of radon.

d. These two terms are similar but differ in that isotopes are stable and radioisotopes emit radiations and are continually disintegrating until they reach a stable state.

e. Any element with an atomic number over 82 and one to one and one-half times as many neutrons as protons in the nucleus will answer this question.

2. The second learning experience is presented primarily as a lecture to be followed by discussion and questions, because little material appeared to be available for the nursing student on this subject.

I. What is fallout?

A. Its nature

1. Explanation of radioactive particles produced by explosions, such as the H-bomb, which fall back upon the earth from the atmosphere. Composed of material drawn up by force of explosion-contaminated with radioactive products of the bomb.

2. It should be respected, but not feared. In heavy concentration it can cause death.

B. Close-in fallout is material returning to earth 10 to 20 hours after blast and within a few hundred miles. It is heavier material pulled down by gravity.

C. Intermediate fallout consists of small particles washed out of lower atmosphere by rain or snow. Is more concentrated in areas of precipitation.

D. Delayed fallout consists of very fine particles blown into higher atmosphere. Important ingredients include Strontium-90. This remains in the upper air so long it is carried to all parts of the globe.

II. Who is affected by fallout?

A. Human life. Practically everybody in this country lives within 200 miles of a potential enemy target. This means we all may have to face the fallout hazard if an enemy should strike with nuclear weapons.

B. Fallout is also a threat to:

1. Animals, fowl, crops, and unpacked foods.
2. It can contaminate homes, cars, yards and fields.
3. It can contaminate water supplies so that they should not be used until they are decontaminated.

III. Is exposure to radiation a new problem?

A. Since the beginning of life, living things have been exposed constantly to radiation from natural sources.

1. Cosmic rays from the skies constantly bombard us.
2. Luminous dials of wrist watches and TV screens produce a small amount of radiation.
3. We receive some exposure when we receive an x-ray.
4. We breathe and eat very small amounts of radioactive material.
5. Our bodies have always contained small amounts of radioactive elements.

B. The greatest danger from radiation comes from external exposure. Radioactive particles or dust settling on the body or clothes.

1. In quantity these can destroy any living tissue, particularly in the blood forming system.

2. A lesser amount can produce skin burns and other damage to uncovered parts of the body.

3. Although you can become seriously, or even fatally ill from breathing radioactive dust or eating or drinking contaminated food or water, this danger is far less than from direct exposure.

IV. A radioactive fallout incident in the Bikini Islands, March 1, 1954.

A. 23 Japanese fisherman in their tuna trawler were caught in the nuclear test area. They were 72 miles from the explosion but were still showered with fallout.

B. The contaminated area extended 220 miles in length and up to 40 miles in width.

C. All men showed blood changes and required treatments of blood transfusions, plasma and antibiotics. One man expired.

D. This incident showed how far deadly fallout could be carried and awakened people to the danger of radiation exposure.

OBJECTIVES & ASSIGNMENTS	EXP. AND ACT. INCLUDING CONTENT
Lesson 4	Lesson 4
To gain an understanding of measurements and units of radiation.	1. Discussion of the questions previously assigned. 2. Introducing through lecture and discussion the following terms: a. Curie b. Microcurie c. Millicurie d. Roentgen e. Rem (RAD)

OBJECTIVES & ASSIGNMENTS	EXP. AND ACT. INCLUDING CONTENT

Lesson 4

f. Milligram-hours
g. Maximum Permissable Dose (MPD)

3. Using the problem-solving technique to familiarize the student with the above terms.

   a. Mrs. E. had a radium insertion in which 90 mg. of radium were inserted into the uterus. The radium was removed 48 hours later. Give the dosage Mrs. E. received in total mg. hours.

   b. Mrs. M. was treated with a radium applicator containing seven 10 mg. needles and one 20 mg. needle. The applicator was inserted on 3-15-61 at 12:00 P.M. and removed 3-17-61 at 10:00 A.M. What was the total dosage of radium in milligram hours?

   c. For diagnostic purposes microcuries of radioisotopes are used. For therapy millicuries are used. Differentiate between these terms and explain why a different dosage is given for diagnosis than for therapy.

Assignment for Lesson 5

Read:

1. Quimby, Edith H., pp. 11-18.

2. Duffy, Benedict J., Jr., "Atomic Energy in the Diagnosis and Treatment of Disease," A.J.N., April, 1955, pp. 439-42.

3. Biddle and Floutz, pp. 241-3.

Crucial Areas for Lesson 4

Understanding and application of units and measures of radiation.

OBJECTIVES & ASSIGNMENTS	EXP. AND ACT. INCLUDING CONTENT
	Lesson 4
	d. What is the maximum permissable accumulated dose of radiation to the whole body for a person 25 years old?

Description of Learning Experiences for Lesson Plan 4

1. The questions assigned for this lesson were based on material presented in the learning experiences for Lesson 3, and the answers are given in the lecture and discussion of terminology presented there.

2. The following units and terms are frequently associated with radio therapy. The nursing student will have a better understanding of radioactivity if she is familiar with these measurements.

a. Curie of a radioisotope is the amount of that isotope which gives off 37,000,000,000, (3.7×10^{10}), atoms per second. It is unwieldly to mention the total number of particles or disintegrations given off per second. It is better to designate this disintegration rate in curies. This unit is used to measure the radioactivity of a radioisotope, a radium needle, or radon seed.

b. Millicurie is one thousandth of a curie or 37,000,000 atoms disintegrating per second.

c. Microcurie is one millionth of a curie or 37,000 atoms disintegrating per second.

d. Roentgen has an official definition which is an extremely technical one, but in human tissue one roentgen delivers a dose which produces about two ionizations per cubic micron, a micron being 1/25,000 of an inch. The roentgen may be considered as that amount of radiation which delivers a dose of one rad.

e. Rem (Rad) means roentgen equivalent man. This is also a very technical term and the student should only need to recognize the term as referring to a dose of ionizing radiation.

f. Milligram hours. The radium dosage is usually indicated in milligram hours--the effect that is produced by one milligram of radium for one hours. Thus, 100 mg. of radium left in place for 36 hours results in a total dosage of 3600 mg. hours of radium.

g. Maximum Permissable Dosage. The maximum permissable accumulated dose to the whole body, at any age, in rads, is equal to five times the number of years beyond 18. Thus, the accumulated MPD = (N-18) X 5 rads, where N is the age and greater than 18.

3. The questions presented for the third learning experience are simple problems which help the student use the terms just presented.

a. Total milligram hours = number of milligrams X number of hours
X = 90 X 48
X = 4320 total milligram hours

b. Total milligram hours = number of milligrams X number of hours
X = (70 plus 20) X 46
X = 4140 total milligram hours

c. In diagnosis it is desirable to use the smallest amount of radioactive material possible. This prevents the patients from having more exposure to radiation than is necessary. In therapy one must use a larger dosage to achieve a desired effect on diseased tissue.

d. MPD = (N-18) X 5 rads
MPD = 5 X 7 = 35 rads

OBJECTIVES & ASSIGNMENTS	EXP. AND ACT. INCLUDING CONTENT

Lesson 5

To acquire knowledge of how radioisotopes are used in the hospital.

Assignment for Lesson 6

Read:

1. Stapelton, Emily W. "A Radioisotope Clinic," A.J.N., Feb., 1959, pp. 224-7.

2. Burns, Patricia and Helen Parker. "When Radioactive Iodine or Gold is Used," A.J.N., Nov., 1956, pp. 1404-6.

Answer the following questions to be written out and handed in:

1. Why is it important for the nurse to know the dosage and half-life of each radioisotope being administered before determining how much time she can safely spend with the patient?

Lesson 5

1. Reviewing the definition of radioisotopes.

2. Discussing the role of radioisotopes in the following:

   a. Diagnosis
   b. Therapy
   c. Research

3. Discussing some of the most commonly used isotopes.

   a. Iodine-131
   b. Phosphorus-32
   c. Cobalt-60
   d. Gold-198
   e. Radium

Crucial Areas for Lesson 5

Knowledge and understanding of radioisotopes most frequently used for therapy and diagnosis.

OBJECTIVES AND ASSIGNMENTS	EXP. AND ACT. INCLUDING CONTENT

Lesson 5

2. How would you reassure the patient who is apprehensive about receiving radiation therapy because he has read acticles in magazines and newspapers discussing dangers of radiation?

Description of Learning Experiences for Lesson 5

1. The definition of radioisotope as distinguished from an isotope was discussed in the first learning experience of Lesson 3.

2. The reading assignment for this lesson familiarizes the student with the use of radioisotopes in diagnosis, therapy, and medical research. The following material supplements the assignment.

a. Diagnostic (tracer) Tests. When a radioisotope enters the body either by mouth or via intravenous injection, it behaves exactly like its non-radioactive brother. For example, radioactive iodine goes immediately to the thyroid gland just like non-radioactive iodine. When a Geiger counter is stationed near the thyroid gland it registers the amount of radioactivity present.

b. Therapy. The principle of therapy with radioisotopes is to deliberately give a large enough dose either internally or as radiation from an external source, as Cobalt-60, sufficient to suppress the activity of certain body cells, or actually destroy them.

Both beta and gamma rays from radioisotopes may be used, just as are x-rays, for the destruction of tumor tissue. They have certain advantages, particularly in that they can be placed in or near such areas and thus irradiate them with less damage to other tissue.

c. Research. Much is being done with radioisotopes to learn more about cancer, heart disease, and the normal aging process. Radioisotopes are valuable in drug research. For example, Sulfur-35 proved that Sucaryl, the noncaloric sweetener, is excreted from the body completely unchanged with no accumulation whatsoever.

3. In discussing the radioisotopes, certain characteristics are important about each:

a. What type of rays are produced?
b. How can the radioisotope be used?
c. What is the half-life?
d. Does the radioisotope have an affinity for a certain body area or of body tissue?
e. Are side effects associated with this drug?

IODINE - 131. Half-life, 8 days; radiations beta and gamma.

This is the most widely used isotope, in both diagnosis and therapy. When I-131 is administered part of it is promptly taken up by the thyroid.

Diagnostic uses:

1. An important test of thyroid function is the determination of the 24-hour uptake of radioiodine. 24 hours after a dose of I-131 has been given by mouth or intravenously, the amount taken up by the thyroid gland is measured with a sensitive scintillation detector placed in front of the neck. This is possible because gamma rays are capable of external detection and can readily be counted. If 15 to 35% of the I-131 has been retained the thyroid is normal. More than 35% retention is indicative of hyperthyroidism, and less than 15% is indicative of hypothyroidism.

2. Organic compounds such as human serum albumin, labeled with radioactive iodine are used to determine blood volumes. The test can be performed on pre-operative patients and repeated in surgery to determine how much blood has been lost.

3. When diiodofluorescein containing I-131 is injected into a patient suspected of having a brain tumor, the radioactive material will concentrate in the tumor, if present, and aid the surgeon in its removal.

4. I-131 is used to label radiopaque dyes for study of kidney function.

Therapeutic uses:

1. Hyperthyroidism is treated with therapeutic doses of I-131. This is more advantageous to the patient than thyroid surgery. In surgery it is possible that too much or too little of the gland will be removed. If the latter happens further surgery is necessary. The patient has a higher hospital bill, a surgical scar and more postoperative pain. With I-131 therapy the patient's bill is lower, he has no scar, and if a sore throat occurs it is similar to one which might accompany a cold.

2. In certain cardiac conditions relief can often be obtained by reducing or suppressing thyroid function, even when it is normal, thus reducing the metabolic rate and lessening the strain on the heart.

Countraindications: I-131 is contraindicated in pregnancy beyond the first trimester, and during lactation.

Side Effects: Immediate side effects are usually mild. Tenderness of the neck, pain on swallowing, sore throat and cough have been reported around the third day after treatment is instituted.

PHOSPHORUS-32. Half-life, 14.3 days; radiation, beta.

This isotope is usually employed in therapy, although it is gaining importance in diagnositc use.

Therapeutic uses:

1. Since phosphorus is taken up by bone tissue, it is given to a patient as treatment in polycythemia vera and in chronic leukemia. Once a patient drinks the fluid containing P-32 it goes to the bones.

   Phlebotomy was at one time the treatment of choice for polycythemia vera. This however, is a palliative measure and does not offer the more lasting effects of P-32 which goes to the bone marrow and decreases the rate of formation of red blood cells.

2. There is no proof that P-32 prolongs the life on the patient with chronic leukemia. It appears to make the patient more comfortable and protracts the periods of remission in this disease. P-32 is not known to be of any value in the treatment of acute leukemia.

Diagnostic uses:

1. P-32 is used in making a differential diagnosis in tumors of the eye. An eye with a malignant tumor takes up a greater concentration than a non diseased eye when the eyes are tested one hour and 24 hours after injection of P-32.

   This is because a tumor exhibits more rapid cell division than normal tissue does. When mitosis becomes more accelerated the requirement for phosphorous becomes increased. Consequently, radioactive phosphorus is expected to concentrate to a greater degree in cancerous cells than in non-cancerous tissues.

   Side Effects: Excessive doses may affect the hematopoietic system including leukopenia, thrombocytopenia, and anemia. Periodic blood examinations should be made in patients treated with radio-phosphorous.

COBALT-60. Half-life, 5.3 years; radiations beta and gamma.

Diagnostic uses:

1. Small cobalt sources, "seeds" and "needles", are used to supplement or replace radium or radon in intracavitary or interstitial treatments. These must be withdrawn when the planned exposure has been given.

2. Large Co-60 teletherapy sources are used for external irradiation in the same manner as high-energy x-rays. Brain and bladder tumors are more affected by Co-60 than by x-ray therapy. More resistant tumors such as lung carcinomas are benefitted about equally by both. Co-60 is often valuable in providing relief of pain for patients in terminal stages of cancer.

   The cobalt unit produces intense radiation and is equal to a 2,000,000 volt x-ray machine.

   Co-60 has many advantages over radium or x-ray as a source of treatment for cancerous tissues:

   1. Because cobalt is a metal it can be fabricated into any shape for more convenient application.
   2. It can be simply produced and made intensely radioactive.
   3. If cobalt is accidently set free in the body it is rapidly excreted, but radium remains in the tissue or bones for years.
   4. Co-60 is inexpensive as compared with the cost of radium.
   5. Co-60 has much less effect on bone than x-ray, so treatment through bony areas with less reaction is possible.
   6. Co-60 causes very little skin reaction in comparison to 250 KV x-ray; consequently much more can be given to the skin than would be possible with the conventional x-ray therapy machine.

Side Effects: The cobalt teletherapy unit at the Billings Deaconess Hospital has been in use since February 1, 1961. Radiologists were hesitant to name definite side effects at the time of this writing. One marked effect on observed patients was the presence of extreme fatigue beginning during the course of therapy and ending approximately 3 to 4 weeks after therapy had ended. Leukopenia was noted. This symptom occurs commonly with x-ray and radiotherapy. No skin reactions had been noted.

Cobalt therapy will be discussed further in Lesson 7 when the radiotherapy department is visited.

GOLD-198. Half-life, 2.7 days; radiations beta and gamma.

Therapeutic uses:

1. The injection of a collodial solution of radioactive gold into the abdominal or chest cavity is considered beneficial in relieving ascites and pleural effusion in patients with a metastatic carcinoma.

Side Effects: Some degree of nausea and vomiting may occur occasionally. Leukopenia may occur.

Countraindications: Radio-gold should not be used in treating leukemia because it is ineffective against acute leukemia and less effective than other therapeutic regimes in the management of chronic leukemia.

RADIUM. Half-life, 1590 years; beta and gamma radiations.

Therapeutic uses:

1. "Tubes," "capsules," or "seeds" of radium are usually used in treating gynecological cases. The radium is placed in the cavity to be treated and left for a planned period of time. In cancer of the endometrium which is believed to be localized the patient is treated with a radium insertion followed at a later date by a hysterectomy. Cancer of the cervix is frequently treated with two to three radium insertions and x-ray therapy. Surgery may or may not be indicated.

   Radium insertions are followed in surgery by the insertion of a barium sulfate packing. The purpose of this packing is to protect normal tissue.

Dangers of radium to the patient:

1. Underdosage seems to increase the rate of growth of a malignancy.
2. Overdosage injures healthy tissue.
3. Latent reaction may be bladder or intestinal fibrosis.

Dangers to handlers of radium:

1. Anemia
2. Sterility
3. Burns, may be slow to heal or become malignant.

OBJECTIVES & ASSIGNMENTS	EXP. AND ACT. INCLUDING CONTENT
Lesson 6 To acquire further understanding of radioisotopes by observing them in use in the radioisotope room.	Lesson 6 1. Discussing the questions assigned for this lesson. 2. Visiting the radioisotope room in the hospital and listening and observing the treatments and explanations being given. 3. Discussing the tour and asking questions. 4. Presenting for discussion the following questions: a. Mrs. S. is to be given a drink of I-131 for a tracer study. She becomes apprehensive when she notes the radiologist handling the cup with tongs, and hesitates before picking the drink up in her hand. How would

OBJECTIVES & ASSIGNMENTS	EXP. AND ACT. INCLUDING CONTENT

Lesson 6

you explain to her why the radiologist takes this precaution?

b. How is disposal of cups for radioactive drinks carried out?

c. Why is a patient receiving radiotherapy slightly undertreated?

d. Why are cosmic rays counted every time a test is to be done?

e. Why is P-32 more effective for polycythemia vera than a phlebotomy?

f. Why must nurses wear gloves when collecting a 24 hour urine specimen from a patient who has received Co-60 for a diagnostic test?

Assignment for Lesson 7

Write answers to any questions from #4 not discussed in class.

Read:

1. Koeck, George P., "Radiotherapy," Nursing World, Oct. 1956, pp. 22-5.

2. Manfredonia, Genevieve. "Radiation Therapy for Cancer of the Cervix," A.J.N., April, 1959, pp. 513-5.

Crucial Areas for Lesson 6

Understanding the procedures and techniques used in the radioisotope room.

Description of Learning Experiences for Lesson 6

1. The two questions assigned for this lesson had not been directly answered by class discussions or the assignment. It was intended for nursing students to answer these questions by relating principles of previous learning experiences to them. The following answers present the principles the nursing student should recognize.

a. Dosage is important because:

1. If microcuries of radioisotopes are used for diagnostic purposes the dosages are too small to present a hazard to the nurse.

2. Millicuries used for therapeutic doses require certain safety precautions. These precautions are based on the half-life of the radioisotope used.

3. When the nurse checks the chart to identify the radioisotope being used and the date the patient received it, she can use her knowledge of the half-life to roughly estimate how long it is safe for her to be with the patient.

b. When a large amount of radiation is given to the whole body within a short period of time, as in a nuclear explosion, the hazard is great and severe illness or death may occur. When limited parts of the body are irradiated, as in medical therapy, the situation is quite different, and the hazards and benefits are carefully considered. The patient under the care of a reputable physician can feel he is in safe hands. Such doctors know what they are doing when they use radioisotopes or x-rays and will protect the patient and his family from dangerous situations.

2. Diagnosis and/or therapy with I-131, P-32, and Co-60 was available at the Billings Deaconess Hospital at the time of this writing. It appeared that a satisfactory visit could be conducted with an informed instructor or x-ray technician acting as guide and narrator. Equipment, techniques, procedures, and precautions should

be explained to and observed by the students.

3. Questions and discussion of the visit might be carried on at the time of the tour or asked upon return to the classroom.

4. A visit to the radioisotope room might easily take one class period. The questions for discussion should have been answered by this visit and if the time element does not permit their discussion in class the group should have no difficulty answering these as a written assignment.

The following are satisfactory answers according to techniques and procedures in practice at Billings Deaconess Hospital:

a. Infrequent exposure is not harmful. If personnel in the radiology department were frequently exposed they would shortly receive a harmful amount of roentgen rays.

b. The containers for radioisotopes are collected in a metal can designated for handling by the radiology personnel only. They are collected by the technician and disposed of by burning.

c. If even a small overdosage of a radioisotope is given, no correction can be made. The radioisotope remains active until its energy is exhausted. Patients are slightly undertreated because it is safer to give more radioisotope at a later date than to risk giving too much at one time.

d. The cosmic rays from the background are continually changing and no two consecutive readings give exactly the same count.

e. A phlebotomy is only a palliative measure and does nothing to slow down the production of red blood cells. P-32, because of its effect on the bone marrow, gives longer lasting and more effective treatment of this disease.

f. Gloves are important because of the long half-life of Co-60. If some urine spilled on the nurse's hands she could wash away the harmful effects. This would be effective unless a break in the skin were present. Co-60 in a cut or break would be difficult to wash away and would be emitting radiations for several years.

OBJECTIVES & ASSIGNMENT	EXP. AND ACT. INCLUDING CONTENT
Lesson 7 To observe the facilities available in the radiology department for radiation treatment.	Lesson 7 1. Defining the term tele-therapy. 2. Visiting the radiotherapy department at the hospital and listening and observing the treatments and explanations being given. 3. Discussing the tour and answering questions. 4. Presenting the following questions for discussion: a. Co-60 emits beta and gamma rays. Since gamma rays are halted by 2" of lead, why does the door to the Co-60 therapy unit have only a fraction of an inch of lead? b. You observed glass in the windows of the doors of the x-ray therapy and Co-60 rooms. Why are glass windows safe? c. What safety measure protects personnel if they walk into the Co-60 therapy unit during a treatment? d. How would you reassure the patient who is about to have radiotherapy and knows someone who "had those

OBJECTIVES & ASSIGNMENT	EXP. AND ACT. INCLUDING CONTENT
Assignment for Lesson 8 Write answers for any questions of #4 not discussed in class. Read: Schiffrin, M. J. The Management of Pain in Cancer, Chicago; The Year Book Publishers, 1956, pp. 181-192. Crucial Areas for Lesson 7 Develop familiarity with the role of x-ray and teletherapy in the radiology department.	Lesson 7 x-ray treatments that make you sick at your stomach?" e. Mrs. R., an out patient, was having a series of x-ray treatments for cancer of the cervix. Noting dryness of her skin she painted her abdomen with merthiolate. Further x-ray treatments produced severe x-ray burns. Discuss health teaching which would have prevented this incident. f. Why is alcohol not rubbed on tissue being treated with x-ray therapy?

Description of Learning Experiences for Lesson 7

1. The purpose of having the students identify the term, teletherapy, is to make them aware that radioisotopes can be administered in another way beside insertion, ingestion and injection. Teletherapy means radiation treatment with the source of radiation remote from the body.

2. A tour of the radiology department would appear most satis-

factory if conducted by the radiologist. A time should be chosen when patients are being treated to give students an opportunity to see what types of medical problems can be treated with x-ray and teletherapy. There should also be time when the radiologist or his technician is free to explain and demonstrate the equipment used. The students should note the precautions which are carried out both for the safety of the personnel and the patient.

3. Discussion and questions might occur at the time of the visit or upon return to the classroom.

4. The questions on radiotherapy presented for discussion are based on the visit and previous learning experiences.

a. The first two questions are based specifically on the Co-60 unit at the Billings Deaconess Hospital. Here the beam of radiation is directed downward at a specific area of the patients body. Only a scatter of radiation is present in the remainder of the room. The door is also protected by its position, e.g. it is located around a corner from the Co-60 unit. The position of the door and the presence of only a scatter of radiation made experts in this field feel a smaller lining of lead offered sufficient protection.

b. The heavy glass in the doors of the rooms are lead glass, e.g. they contain enough metal alloy to maintain safety.

c. The Co-60 machine cannot be turned on unless the door to the therapy room is closed. If the door is at anytime opened during a treatment the machine automatically turns itself off.

d. Except in unusual cases, the ordinary radiation treatment does not make the patient sick and it is rarely necessary to suspend treatment because of nausea and vomiting. The fearful, apprehensive or unstable person has a greater tendency toward these symptoms according to the authorities in this field.

e. Merthiolate, mercurochrome, or any drugs containing heavy metals are countraindicated in patients receiving x-ray therapy. The

metal attracts the x-ray and the patient receives secondary irradiation from its presence.

f. Alcohol is contraindicated because of its drying and irritable effect on tissue exposed to x-ray therapy.

OBJECTIVES & ASSIGNMENTS	EXP. AND ACT. INCLUDING CONTENT
Lesson 8	Lesson 8
To gain familiarity with the less commonly used radioisotopes.	1. Listening to lecture on and asking questions about the following radioisotopes: a. Carbon-14 b. Sodium-24 c. Iron-59 d. Cesium-137 e. Strontium-90 f. Sulfur-35 g. Chromium-51
To review or clarify the student's understanding of radioisotopes in relation to the second overall objective for the unit.	2. Discussing similarities and differences between the manifestations drugs and radiation produce in the body. 3. Presenting a case study of a patient receiving radioisotope therapy. 4. Discussing any questions or problems about radioisotopes before going on to nursing care and precautions.
Assignment for Lesson 9	Crucial Areas for Lesson 8
Read: 1. Quimby, Edith H., Safe Handling of Radioisotopes in Medical Practice, pp. 64-80.	1. Familiarity with less frequently used radioisotopes. 2. Similarities and differences between effects of drugs and radiation on the body. 3. Review concepts presented for second overall unit objective.

Description of Learning Experiences for Lesson 8

1. The first learning experience was presented as a lecture because little material on the radioisotopes to be discussed was presented in textbooks or nursing journals available to nursing students.

a. Carbon-14. This radioisotope has an extremely long half-life, about 5000 years. It emits only beta rays. It is useful in diagnostic procedures because carbon is found in all body cells. The body apparently does not distinguish between the stable element carbon and the radioactive C-14. Thus investigators can add tracer amounts of C-14 to carbon compounds, such as sodium bicarbonate, to study the processes of digestion, absorbtion and metabolism.

b. Sodium-24. Na-24 can be incorporated into the compound sodium chloride, which is introduced into the blood stream of a patient. Radiations from the isotope are then measured in various locations in the circulatory system, and extensive information as to the speed of normal circulation in various parts of the body can be gained. Such studies can be carried out on a patient who has a crushed limb and determine if amputation is necessary. In a burned patient being treated with skin grafts, the extent of circulation in the graft may be established by similar studies.

c. Iron-59. Fe-59 has a half-life of nearly 50 days. It emits beta and gamma rays. It has proven helpful in a study of the production of red blood cells and hemoglobin in anemia. Administered intravenously, it helps evaluate iron deficiency states. Uptake of Fe-59 increases in hypochromic anemia and decreases in aplastic anemia as well as anemia secondary to infection.

d. Chromium-51. Cr-51 is used to determine the red blood cell survival rate.

e. Sulfur-35. Su-35 has been incorporated into proteins and used to study various aspects of protein metabolism.

f. Cesium-137. Ce-137 does not concentrate in bone or any single tissue but is distributed throughout the body. This distribution makes it a treatment of choice for leukemia where entire body radiation is believed to be the best therapy.

Oak Ridge Institute of Science at Oak Ridge, Tennessee has an octagonal underground structure of concrete. In each of the

eight corners is a lead disc containing pellets of cesium trained to cover the patient's entire body.

g. Strontium-90. Sr-90 has been of great value in the treatment of various diseases about the eye, such as pterygiums, and other similar ocular lesions which are greatly aided by the beta radiations from the strontium.

Sr-90 is the isotope formed in the air when the atomic bomb is exploded. This chemical substance falls to the ground and gets on the grass mostly in the midwestern states. The cows eat the grass and swallow the strontium which, when in the body, acts like calcium. When we drink the cow's milk we swallow a certain amount of radioactive strontium, which goes to our bones. Extensive research is now showing that the total amount anyone in the United States has received up to now is not harmful.

2. The second learning experience was presented because the author felt that the nursing student would have a better understanding of the effect of radiation upon the body if she could compare it with something with which she was already familiar, such as the action of drugs upon the body.

The site of drug action as well as radiation action is the cell, the biological unit of life. Similarity between drug action and radiation effects is so close that certain substances such as colchicine and the nitrogen mustards, have been called "radiomimetic" drugs.

Manifestations common to drug action and radiation effects:

1. With respect to ways of action, both yield local as well as systemic effects.

2. Effects may appear immediately or after varying amounts of time. Latent periods are characteristic of but not specific for action of radiation.

3. Drugs and radiation yield reversible and irreversible effects. The similarity ends here and more analysis yields fundamental differences between drugs and radiation.

Differences:

1. Reversibility of drug effects is common, for example, anesthesia shows a reversible action. Reversibility of radiation effects hasn't been carried out without artificial interference, such as cooling or washing irradiated tissues. Without this interference irradiated cells and tissues will show irreversible changes. In other words only a "pseudo recovery" can exist with radiation effects while "true recovery" exists with drug actions.

   Recognition of irreversibility of primary effects of radiation is one essential characteristic determining its uses in therapy.

2. An increase in function without a subsequent loss of function can be accomplished with drugs. In radiation, increase at one time is followed by decrease at another time. This is because irradiated cells age prematurely due to cell deaths. An example--stimulation of menstruation by irradiation of ovaries will produce a destruction of graafian follicles causing ammenorhea.

3. Drug effect depends on the extent to which the drug can permeate the cell membrane. The obstacle of the cell membrane does not exist with radiation.

3 and 4. These learning experiences are self-explanatory and would be determined by the case material available at the time this lesson was to be presented and by the questions or problems of the class.

OBJECTIVES & ASSIGNMENTS	EXP. AND ACT. INCLUDING CONTENT
Lesson 9 To understand nursing precautions needed with radioisotopes and the principles of these precautions.	Lesson 9 1. Discussing how radioisotopes may be hazardous to nurses. 2. Discussing the following: a. What are precautions needed with radioisotopes? b. Upon what principles are these precautions based? c. How can the principles of time and distance be incorporated into bedside care? 3. Designing a nursing care program for a patient undergoing radioisotope therapy.
Assignment for Lesson 10 Read: 1. Principles of Radium Precautions and Rules for Handling Patients Receiving Radioisotopes. Procedure Manual, Billings Deaconess Hospital. 2. Quimby. pp. 59-75.	Crucial Areas for Lesson 9 1. Sources from which radioisotope hazards may arise. 2. Precautions and their underlying principles needed with radioisotopes. 3. Use of principles of precautions in giving nursing care.

Description of Learning Experiences for Lesson 9

1. A discussion of the first learning experience should bring out that there are three particular areas in which nursing students could become irradiated by radioisotopes. These are:

a. Irradiation of the nurse by radiations emitted by the radioactive isotopes in the patient.

b. Accidental contamination of the skin by radioactive materials in the course of patient care. An example of this might be the accidental spilling of a bedpan or urinal.

c. Accidental ingestion of radioactive material. This could occur by such things as smoking or applying lipstick when the hands are contaminated. Ingestion presents an internal hazard to the body different than that of external irradiation. First, the radiation will persist until the isotope has exhausted itself and second, since it is in immediate contact with living cells, it can injure by even producing a relatively small amount of radiation.

The last two areas of possible irradiation can be largely prevented if the nurse observes a faithful hand-washing routine. This will be discussed under general nursing principles.

2. In discussing precautions it is important that the nursing student recognize that safety precautions need concern her only when her patients have had <u>therapeutic</u> doses of radioisotopes. As was mentioned previously, diagnostic doses are very small and present a minimal hazard except in the laboratory where they are prepared.

a. Alpha particles can be stopped by as thin a substance as a sheet of paper. They present little or no external hazard to the nurse. Beta radiations are stopped by the patient's body. Precautions against them concern the body excretions, soiled linen, and vomitus during the period of radiation. Phosphorus having only beta radiations, involves only this principle in care. Gamma radiation does travel through body tissue and the safety principle of time, distance, and shielding apply for the nurse.

b. All radiation precautions for gamma and x-rays are based on the above three principles.

Time: Reduce the time spent in the vicinity of the patient who has had a therapeutic dose of a radioisotope. The shorter the time the nurse is in the room, the less the amount of radiation she receives.

Distance: Increase the distance between the nurse and the patient as soon as possible. Distance means that the farther away from the patient the nurse is, the less radiation coming from the patient's body she will receive.

Shielding: Alpha and frequently beta radiations are stopped almost completely by layers of cloth and rubber gloves. The nurse should use rubber gloves when handling anything which is moist and contaminated.

c. Incorporating the principle of time into bedside care.

First of all the nurse should plan nursing care the patient receives before he receives the isotope.

The nurse can then render all the necessary care beforehand, such as complete bed bath, clean linen and so forth.

After the isotope has been given the nurse will render only nursing care that is absolutely necessary, so she will reduce the time she is in the room.

Work should be planned so that all necessary attention is given to the patient, while staying in the room a minimum length of time.

Should the patient's treatment take longer than the time allowed by the radiological safety officer, plan your work so you can be relieved by another nurse. When work is staggered this way, the radiation dosage is diluted. Over a week's or month's time, a dose can be tolerated that would be hazardous if received in a minute or so.

Incorporating the principle of distance into bedside care.

The bed of the patient receiving radioisotope therapy should be placed on the ward farthest away from the nurses' station.

Remember the nurse can converse satisfactorily with a patient by standing in the doorway. She does not need to lean over a bed to talk.

Ask visitors to stay away from the bedside. Encourage them to remain in the room only a short time.

Explain to the patient why the visiting of the family must be limited and why the nurse stays in the room only long enough to perform specific nursing duties.

3. In designing a nursing care program the nursing student needs to remember that the precautions which are used are really only applications of common sense. If she keeps this in mind and knows the following information she will be able to outline a satisfactory program of patient care.

Information to know:

The name of the isotope being administered.
The type of rays it emits.
The half-life.
Date of administration of the isotope.

The student might take one radioisotope, such as I-131, and plan nursing care for one patient, in a hypothetical situation presented by the instructor.

OBJECTIVES & ASSIGNMENTS	EXP. AND ACT. INCLUDING CONTENT
Lesson 10 To develop awareness of specific nursing instructions for different types of radioisotope medication.	Lesson 10 1. Discussion of nursing care and precautions to be observed for: I-131 Co-60 Radium and Radon P-32 Au-198 2. Discussing the following situations: a. The nurse noted a beet-red stain on Mrs. R's dressing. Mrs. R. had received an injection of Au-198 earlier in the day. What steps would you suggest the nurse to follow in handling this situation? b. If you were in an isolated area where there was no radiation department what would you do about hands or a uniform contaminated with radioactive gold? 3. Reviewing the chart of a patient receiving radioisotope therapy. a. Determining what teaching needs this patient might have.
Assignment for Lesson 11 Read: 1. Nelson, Katherine R., "What's New in Cancer Nursing?" Nursing World, Feb. 1959, pp. 13-15. 2. Rhoads, Cornelius. "Cancer Control-Present and Future," A.J.N., April, 1958, pp. 516-9.	

OBJECTIVES & ASSIGNMENTS	EXP. AND ACT. INCLUDING CONTENT
Assignment for Lesson 11 Answer the following questions: 1. What explanation would you give to the practical nurse who is fearful about caring for a patient receiving radiophosphorus? 2. Why is it important to handle urine of a patient receiving radioactive iodine carefully? 3. After a patient has had gold seeds of radon implanted in his tumor, does he present any radioactive hazard to the nurses coming in contact with him?	Lesson 10 b. Developing a nursing care plan which will satisfy the patient's need. Crucial Areas for Lesson 10 Specific principles for nursing care of patients receiving the more frequently used radioisotopes.

Description of Learning Experiences for Lesson 10

1. Particular nursing precautions to be observed with I-131:

Urine: I-131 goes to iodine selecting tissues of the body and while it is there is expected to eradicate any adjacent tissue. It is excreted in the urine.

The nurse should wear rubber gloves when collecting urine. She should wash her hands with the gloves on and again after they are removed.

The patient should be encouraged to collect his own urine.

For the first 24-48 hours all urine may have to be collected for assay by the radioisotope laboratory. Special containers may be provided by the laboratory for this.

Visitors: Patients are allowed visitors in accordance with usual hospital rules unless other instructions are given. For the first few days they should sit at least 3 feet away from the bed.

No special precautions are needed for dishes, instruments, or utensils.

If the patient received the dose IV and subsequently vomits, no special precautions are necessary.

Vomiting within 24 hours after oral administration, urinary incontinence, or excessive perspiration within the first 48 hours may result in serious contamination of linen or floor. Call the doctor or radiology department for instructions.

Radium, Cobalt-60, and Radon:

Nursing care for patients receiving interstitial radium or Co-60 is very similar and these might be discussed together. The patient receiving Co-60 as teletherapy is not radioactive when not undergoing a treatment and presents no hazard to personnel or visitors. Radon, because it is an alpha emitter only, once implanted into the tumor presents no danger to the nurse or members of his family coming in intimate contact with him. His body absorbs the alpha rays.

The procedure manual gives thorough directions on handling of patients with radium sources. Should an entire applicator of radium be accidently ejected by the patient, the Atomic Energy Commission recommends the following:

1. Secure long forceps and a stainless steel dressing pan.
2. Place the applicator in the pan, handling with forceps only. Place there also all dressings and so forth.
3. If the patient is in a single room, place the pan in a corner; if on a ward, place the pan in the utility room as far from personnel as possible.
4. Call the physician or the radiology department.

At the time of a radium insertion into the cervix, a Foley catheter is inserted to prevent the radiation burns that occur when a distended bladder comes in contact with the uterus. Such burns are often forerunners to fistulas. The nurse should observe the patient for symptoms indicative of this condition, including leaking of urine or feces from the vagina or the patient complaining of "leakage around the catheter."

Perineal care is omitted to avoid danger of dislodging the radium and to avoid exposing the nurse to unnecessary contact with the patient's pelvic region.

The doctor should be notified at least 30 minutes before the radium is to be removed, because accurate dosage is partly dependent on the length of time the applicators are left in.

Phosphorus-32

Phosphorus is a beta-emitter only, and consequently there are usually no precautions used with patients. The only real hazard is the patient who vomits immediately after receiving an oral dose. For the first day provision should be made for vomiting and a container should be within easy reach of the patient. If vomiting occurs this container should be isolated in the room as far as possible from the patient, and the doctor or radiology department notified.

For phosphorus administered intravenously, no special precautions are necessary for vomitus.

Gold-198

Following an injection of Au-198 the patient is radioactive because he is a source of gamma radiation.

Surgical dressings should be changed only as ordered by the physician in charge. Au-198 will stain dressings or linen red or purple. If the nurse notes a beet-red stain on the patient's dressing, she should leave it alone and immediately contact the doctor.

Linen is only contaminated if the isotope itself gets on it.

Visitors are allowed unless other instructions are given. For the first few days they should sit at least three feet away from the bed.

When collodial gold is injected into a body cavity the patient must be turned every 15 minutes, first to his left side, next on his abdomen, then on his back, and then on his right side. This is carried out for two complete rotations that can be completed in two hours. This insures even distribution of the Au-198.

Should a patient expire shortly after administration of either I-131 or Au-198, a tag is affixed to the body to indicate the type of radioactive isotope that was given and the route of administration.

2. a. The nurse should leave the dressing alone and call the doctor immediately. This dressing should be removed with very careful handling and taken immediately to the radiation department. The nurse should avoid getting her hands or uniform contaminated with the isotope. If she

does, she should question the radiation department as to the best way to decontaminate them.

b. The nurse should wash her hands under running water to remove as much of the isotope as possible. This is the same principle as the running-water scrub in medical asepsis. Remove the uniform and set it aside (using the principles of time and distance) until the decay rate had caused the isotope to disappear. In relation to gold, fifteen-sixteenths would decay in two weeks, so at the end of about two weeks the uniform could be put into the regular laundry, with little danger to anyone.

OBJECTIVES & ASSIGNMENTS	EXP. AND ACT. INCLUDING CONTENT
Lesson II	Lesson II
To develop basic rules usable in planning the nursing care of patients receiving radioactive isotopes.	1. Review the three principles of radioisotope precautions; time, distance and shielding. 2. Through group discussion develop 10 or more basic rules for nurses to use when planning the nursing care of patients receiving radioisotopes. In developing these criteria which govern nursing care, keep in mind the above principles and the specific nursing instructions discussed in the previous lesson. 3. Attending a class on the ward with a patient who has received radioisotope therapy.

OBJECTIVES & ASSIGNMENTS	EXP. AND ACT. INCLUDING CONTENT
	Lesson 11
	4. Discussing the care of the patient, involving recognition of nursing care problems.
Assignment for Lesson 12	
Read:	
1. Sambrot, William. "Nine Days to Die," The Saturday Evening Post, July 9, 1960, p. 37	Crucial Areas for Lesson 11
2. Alsop, Stewart and Ralph E. Lapp, "The Strange Death of Louis Slotin," The Saturday Evening Post, March 6, 1954, p. 25.	1. General rules governing nursing care for patients receiving radioisotope therapy.
3. Shriffrin, M. J. pp. 191-2.	

Description of Learning Experiences for Lesson 11

1. The review of principles of radioisotope precautions was presented as a basis for the students in planning general rules of nursing care. Most nursing care principles can be derived by remembering the three fundamental principles of time, distance, and shielding.

2. The following are basic rules the author felt were important to remember in planning nursing care:

First check the patient's chart to find what radioisotope he received and why, what the dosage was and when he received it.

Determine to what extent the patient knows and understands what is going on. Teach him proper handling of himself and/or his excreta, if necessary.

Arrange for special disposal and handling of contaminated materials, if necessary. This includes linens and dressings which may become contaminated when certain isotopes are used.

Nursing care should be speedy but adequate during the time the patient is emitting gamma radiation.

Wash hands with soap and water after administering care to a patient who has had a radioisotope.

Do not touch your fingers to your face while caring for a patient who has had a radioisotope.

Wash gloved hands with soap and water before removing them if they become contaminated.

If a patient dies after a radioisotope has been administered, place a tag on his body, giving information concerning the kind of isotope used, the dose, and date of administration. Do nothing further until the radiologist or physician directs you.

Never touch a dislodge radium needle. With long handled forceps place it in a container, preferably lead. Call the doctor immediately.

Never care for a patient who has had radioisotopes administered to him if you have an open skin lesion.

Explain to the patient why the nurse does not remain in the room after completing specific nursing duties, why she wears a gown and gloves, and why friends and relatives must remain outside the room.

Provide the patient with some form of entertainment.

Remember that once the radioactivity of a radioisotope has decayed, there are no significant radiations left, no further precautions necessary.

OBJECTIVES & ASSIGNMENTS	EXP. AND ACT. INCLUDING CONTENT
Lesson 12	Lesson 12
To gain awareness of the incidence of radiation sickness; its symptoms, course and etiology. To understand the principles of supportive care for patients with radiation sickness.	1. Listening to the instructor present the biological effects of radiation on humans according to the amount received. 2. Etiology of radiation sickness. 3. Discussing symptoms and incidence of: acute radiation sickness delayed radiation reactions 4. Class discussion of supportive measures of nursing care and treatment for radiation sickness.
	Crucial Areas for Lesson 12
	1. Acute and delayed radiation effects on body tissue. 2. Supportive nursing measures for radiation reactions.

Description of Learning Experiences for Lesson 12

1. The biological effects of radiation according to the dose received are given to help the student gain an idea of the amount of radiation which produced different effects upon the body.

Dose in Roentgens	Biological Effects[32]
0-100	No acute effects.
100-200	Radiation sickness; recovery in a few days.
200-300	Radiation sickness; for a few death after several weeks.
300-400	Death for about one-third of the exposed persons within several weeks.
400-600	Death for 35-90%.
1000	No survivors; death within one week.
4000	Death within two days.

The above biological effects occur only if the dose is administered at one time. The nursing student should remember that patients receiving teletherapy such as Cobalt-60, over a period of 5 to 6 weeks may receive 3000 to 5000 or more roentgens. The biological effects are different because the administration expands over a period of time.

2. The etilogy of radiation sickness has been blamed on various causes. It has been attributed to inhalation of ozone produced in the air by radiation and by odors in treatment rooms. Some say it is entirely neurotic in origin. It occurs most often in neurotic individuals and those who are in poor general health and prone to

[32]Fowler, John. Fallout, New York; Basic Books Inc., 1960, pp. 166.

digestive disturbances. Many blame it on complex and diverse metabolic disturbances.

3. Acute Radiation Sickness: The symptoms and signs may be arranged in five groups:

a. General-headache, dizziness, weakness, abnormal sensations of taste and smell.

b. Gastro-intestinal-anorexia, nausea, vomiting, diarrhea.

c. Hematologic-leukopenia, thrombocytopenia and anemia.

d. Cardiovascular-arrhythmia, tachycardia, hypotension.

e. Psychic-insomnia, fear, instability.

Roentgen sickness occurs most frequently after the second week of treatment unless the liver and epigastrium are treated, in which case it occurs earlier. At first it comes on about an hour after treatment, lasting about one hour. It consists of mild exhaustion and shock, with a slight degree of nausea. Later it may become worse, lasting all day. Vomiting may occur. At time headaches, chills and fever may occur.

In severe and acute radiation sickness such as occurred at Hiroshima, 95% of the people who were within one-half mile of the blast center died. Many not dying immediately came down with the symptoms mentioned previously. There was marked leukopenia, usually below 4000, loss of hair, bloody diarrhea, urine and sputum. Petchiae, purpura, and blindness occurred in many victims not immediately killed by the blast.

Delayed Radiation Reactions:

Prolonged or repeated exposure to ionizing radiations may result in amenorrhea, anemia, leukemia, leukopenia, cataract formation, cancer or temporary sterility.

Much has been said lately about the risk of radiation to future generations. In the light of present knowledge the amount of radiation the potential parents are receiving is accepted as practically insignificant.

4. Supportive measures for

Acute radiation sickness:

a. No specific remedy has yet been found.
The patients should be encouraged to eat a bland, high-caloric diet. Increased sugar intake and Vitamin B complex are indicated. Vitamin C is also believed important.

b. Rest is extremely important and sedation if often indicated.

c. If the patient has undergone extreme radiation exposure, the care is very similar as that for a major thermal burn.

d. Bone marrow transplants may be done to yield blood forming cells enabling the patient to survive until his own blood-forming cells regenerate.

e. Blood transfusions, plasma and antibiotics are a part of the treatment.

f. Dramamine has been found helpful in relieving symptoms.

Chronic delayed radiation sickness:

a. The most important considerations are recognition of the condition and removal of the patient from the offending radiation.

b. Use of a radon ointment is valuable in treating chronic skin ulcers. Radon ointment is rich in vitamins, non-irritating and promotes healing.

c. For anemia, blood transfusions and other symptomatic therapy are indicated.

CHAPTER IV

SUMMARY AND RECOMMENDATIONS

Summary

The investigator felt there was a need for a unit of radiation nursing to be introduced into the medical-surgical curriculum of the educational program of Montana State College School of Nursing. The subject of radiation nursing was an area in nursing education which was in the process of development because of a broadening of concepts since World War II, which brought x-rays and radioactive isotopes into wide use.

The hypothesis of this study was: that the available information on radiation medicine could be organized into a unit of study on radiotherapy and the principles of nursing care, for presentation to nursing students during the second clinical quarter on the medical-surgical nursing service.

This investigation was concerned with the development of a course outline for students which reviewed basic chemistry principles, related them to the study of radiotherapy and presented principles of nursing care. The overall objectives for this outline were that the nursing student develop (1) the ability to understand the interrelations of the fundamental principles of radiation and the basic concepts of inorganic chemistry, (2) a knowledge and understanding of radioisotopes as they are used in the hospital for diagnosis and therapy and (3) the ability to identify the important principles of nursing care for patients receiving radioisotope therapy.

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A documental method of research was selected for this study and previously written data was collected. The material selected was the most recent available and the investigator attempted to use those opinions agreed on by the majority of specialists.

The Tyler rationale, Bloom's taxonomy, and the Philosophy of Montana State College School of Nursing were employed to develop objectives, screen objectives and select learning experiences.

Learning experiences were developed with an attempt to give the student the opportunity to directly participate in situations related to the content areas. Active participation in the various situations was not always feasible. The absence of a textbook on radiation nursing and the difficulty in securing available material for nursing students which covered certain areas of radiation sometimes made achievement of more desirable learning situations difficult to arrange. Some learning experiences were presented as lectures, thus giving the nursing student the role of the listener. Whenever possible, the situation was simulated through the use of teaching aids such as case material, observation visits, group discussion and situational problems.

In building an organized group of learning experiences the investigator attempted to begin with material with which the nursing student was familiar. Opportunity was given for the student to further develop and understand this material before proceding to more complex treatment of the subject. Each successive learning

experience was built upon the preceding one and the experiences as a whole were planned to give the student a unified and comprehensive view of radiation nursing.

The investigator canvassed subject matter for this unit and presented appropriate and more readily available material in the form of assignments to the nursing student. Material from sources difficult for the student to obtain was presented in the descriptions given succeeding each learning experience. The descriptions of learning experiences were designed to supplement the students' assignments rather then review or repeat the same material.

Recommendations

The following recommendations for further study have been suggested by the investigator:

1. For the Nursing Faculty:

   This unit of study by tested by trial as follows:

   1. A pre-test be given at the beginning of this unit to determine the readiness of the students and their individual differences.
   2. The implementation of this unit into the medical-surgical curriculum taught during the nursing students second clinical quarter in Medical-Surgical Nursing.
   3. An evaluation be made to determine whether or not the learning experiences accomplished the overall objectives of the unit.
   4. An evaluation be made which would determine the most effective teaching methods as applied to specific content.

II. For Instructors in Supporting Departments:

1. A need for study in the field of radiation be made known to departments offering supporting courses to nursing students. Emphasis placed on relationships between these supporting courses and radiation to provide background information for pre-clinical nursing students.

III. For Inservice Education or Continuing Professional Education:

1. A presentation of the content of this unit as an inservice education program for professional nurses.

2. A program be employed whereby professional nurses engaged in active nursing be kept abreast of changes and developments in radiation nursing.

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