

Special Contribution

# Introduction of Radiological Nursing into the Curriculum of Basic Nursing Education Systems

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The early introduction of radiological nursing education into the basic nursing education system will be a very important issue. Nursing personnel contacted closely with clients (patients and general public) at any time were recently dubbed “key-person” in team medical care. The attitude of nursing personnel may influence the anxiety of their clients about radiation and its health effects. After the nuclear power plant accident occurred in Fukushima prefecture, it was evident that overall medical professionals in Japan, including nursing personnel, lacked basic skills in regard to radiation exposure and possessed defective knowledge on its health effects. The usage of radiation and radionuclides are increasing year by year in every field, particularly in medical field. The goals in utilization of the artificial radiation were maintain the safety of all exposed people including patients. At all exposure situations, the role of nursing personnel are to be accountable on site and to consult with clients, including patients, on radiation exposure and its health effects. There were many epidemiological studies about radiation health effects. Also research and development concerning radiation dosimetry has advanced greatly. Nursing personnel has to use effectively these information and technics during consultation with clients.

In addition, it is necessary to start to train quickly the certified nurse specialist (CNS) in radiological nursing for the retention of teaching staff for radiological nursing education. Public health nurses also have to get particularly the skill on risk communication based on scientific data.

*Key words:* Radiological Nursing, curriculum, nursing education, radiation protection, CNS

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## 1. Introduction

After the nuclear power plant accident occurred in Fukushima prefecture in 2011, it was evident that overall medical professionals in Japan, including nursing personnel, lacked basic skills in regard to radiation exposure and possessed defective knowledge on its health

effects.

At present, radiation and radionuclides are used frequently in everyday life, and radiation diagnosis, radiation therapy and IVR are performed daily especially in the medical field. The numbers of PET examinations in Japan have also increased sharply over the past ten years. Presently there are approximately 44,000 CT scanners in 35 countries in the world, and approximately 60% of these CT scanners are in Japan and the United States<sup>1</sup>. The usage of radiation and radionuclides are increasing year by year in every field, such as medicine, agriculture and energy. In spite of radiation being one of the risk factors

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for human health and of environmental destruction, nursing personnel are unfamiliar with radiation and radionuclides. Therefore, the early introduction of radiological nursing education into the basic nursing education system will be a very important issue in the future.

## 2. The roles of nursing personnel in the usage of radiation and radionuclides

### 2.1. Establishment of radiological nursing oriented radiation protection

We have to use artificial radiation and radionuclides carefully in order to maintain the safety of all exposed people including patients. Therefore, the goal of radiological nursing is the establishment of variable functions of radiological protection based on nursing skill.

Basic concepts of radiological protection consist of three items, “Justification”, “Optimization” and “Dose Limitation”, which were recommended by the International Commission on Radiological Protection (ICRP)<sup>2)</sup>.

“Justification” in the medical field refers to decisions on the application of medical treatment to patients and is currently the responsibility of physicians only. Nursing personnel have no role in the “Justification” process.

There are three classifications of exposure situations from the viewpoint of radiation protection: planned exposure situations, emergency exposure situations and existing exposure situations<sup>3)</sup>.

Planned exposure situations are everyday situations involving the planned operation of radiation sources. Emergency exposure situations are an unexpected situation that occurs during the operation of a radiation source and require urgent action. In emergency exposure situations, all sources are outside the control of human activity. Existing exposure situations are exposure situations that already exist in radiation sources and where a decision on control has to be taken. The current situation after the nuclear plant accident at Fukushima is a typical existing exposure situation. In addition, categories of radiation exposure are also divided into three exposure types involving occupational, medical and public exposure.

### 2.2. The roles of nursing personnel in radiation protection

All nursing personnel including nurses, public health nurses and midwives are expected to be concerned with all exposure situations and all exposure categories as professional experts.

At all exposure situations, the role of nursing personnel are to be accountable on site and to consult with clients, including patients, on radiation exposure and its health effects. In an emergency exposure situation, nursing

personnel provide the following roles: nursing care and treatment, consultation for evacuated people, and emergency radiation medicine. Emergency radiation medicine is offered to patients in severe condition.

In the case of accidents at nuclear power plants, stable iodine is occasionally prescribed to children and young persons. Nursing personnel are required to respond appropriately to these clients.

## 3. The anxieties and misunderstandings of nursing personnel about radiation exposure and its health effects

### 3.1. Anxieties of nursing personnel concerning the health effects of radiation

The main anxieties of the health effects of radiation are cancer, hereditary effects, sterility and malformation of embryos and fetuses<sup>4)</sup>. Although the occurrences of these effects depend on the degree of real individual exposed doses, almost all nursing personnel may be ignoring the relationship between exposed doses and effects. The anxieties of radiation exposure and its health effects result from a misunderstanding about radiation and its exposure.

### 3.2. Misunderstandings of nursing personnel concerning radiation exposure and its health effects

Nursing personnel have the following misunderstandings about radiation exposure and its health effects: neglecting the relationship between exposed dose and each radiation effect; believing that the biological effects from internal exposure and from external exposure were different; believing that the health effects from natural background radiation and from artificial radiation sources were different; believing that radionuclides would remain permanently in the body; and believing that DNA damage was unrepairable.

This misunderstanding of radiation exposure and its health effects causes the anxieties of nursing personnel<sup>5)</sup>.

### 3.3. Characteristics of radiation exposure and its health effects from the viewpoint of radiological protection

It is necessary for nursing personnel to understand correctly the characteristics of radiation health effects and radiation dosimetry.

The system of radiological protection was constructed using much scientific data from epidemiological studies about radiation health effects, such as the Life Span Study of Hibakusha at Hiroshima and Nagasaki. Throughout these epidemiological studies, the relationship between radiation effects and individual exposed doses were clear<sup>6)</sup>.

In addition, research and development concerning radiation dosimetry has advanced greatly. Furthermore,

**Table 1.** Minimum required necessary knowledge and skills for nursing personnel

- Principles of radiation and radionuclides
- Categories of radiation exposure
- Usage of radiation and radionuclides in everyday life
- Health effects and risks of radiation
- Technique of radiation protection for external and internal exposures
- Technique of prevention of spreading of radioactive contamination in the environment
- Dose limits for nursing personnel
- Risk communication

**Table 2.** Minimum required necessary knowledge and skills of emergency radiation medicine for nursing personnel

- Biological Effects (early radiation effects)
- Control techniques of the prevention of contamination of radionuclides
- Medical treatment for patients contaminated by radionuclides
- Techniques of collection of biological samples for dose estimation of victims
- Radiation protection technique for external exposure

the very small amounts of radiation and radionuclides in the environment and the small amount of exposed doses from internal and external exposures are detected easily by the use of measurement equipment.

Nursing personnel have to use such scientific information and high quality techniques effectively when responding to clients.

Nurses are called the key person in team medical care. The attitude of nursing personnel may influence the anxiety of their clients about radiation and its exposure. The appropriate response to clients is a very important role of nursing personnel. However, at the present time, it is undeniable that nursing personnel have not only a lack of knowledge and skills but also a misunderstanding of radiation and its exposure. This is the reason that the early introduction of radiological nursing into the basic nursing education system is necessary<sup>7)</sup>.

#### **4. Introducing “Radiological Nursing” into the curriculum of the basic nursing education system**

Nursing personnel are expected to master the following knowledge and skills of radiological protection (Table 1) in order to provide the appropriate professional response to clients in all exposure situations and in all exposure categories: (1) Principles of radiation and radionuclides, (2) Categories of radiation exposure, (3) Usage of radiation and radionuclides in everyday life, especially in the medical field, (4) Health effects and risks of radiation, (5) Techniques of radiation protection for external exposure, (6) Techniques of prevention of spreading of radioactive contamination in the environment, (7) Dose limits for occupational exposure including exposure of nursing personnel, and (8) Risk communication skills<sup>7)</sup>.

Nursing personnel are expected to master the

following knowledge and skills of emergency radiation medicine (Table 2): (1) Biological effects, particularly the effects of early tissue reaction such as radiation sickness, and skin injuries, (2) Control techniques of contamination of radionuclides, (3) Medical treatment for patients contaminated by radionuclides, (4) Techniques of collection of biological samples for dose estimation of victims, such as blood, urine, feces and nose smears, and (5) Radiation protection techniques for the prevention of radioactive contamination and external exposed doses.

#### **5. Radiological Nursing Curriculums**

The goal of radiological nursing education is for all nursing personnel to master the minimum required necessary knowledge and skills. When this goal is achieved, all nursing personnel will be able to respond appropriately to patients and the general public without anxiety about radiation.

During the basic education process, practice and experimental studies are very useful to easily understand radiation and radionuclides<sup>8)</sup>.

The retention of teaching staff for radiological nursing education is very important, but at present obtaining teaching faculty from the field of nursing is very difficult. In the future, Certified Nurse Specialists (CNS) in Radiological Nursing may be in charge of education among the teaching faculty. Presently, radiation technicians have the role of teaching radiological nursing because they have been systematically educated in radiation protection during their basic education.

Our university, Tokyo Healthcare University, is now trying to introduce radiological nursing in the second year of the basic education curriculum.

The curriculum of nursing education consists of

**Table 3.** Occupational exposure doses of female workers in the medical field in Japan

Individual dose mSv / 3 months	Female radiation works in medicine (medical doctor, nurse, radiation technician)			
	1st quarter	2nd quarter	3rd quarter	4th quarter
No-detected	85,801	85,797	85,710	85,905
0.10- 1.00	10,289	10,146	10,355	10,107
1.01- 5.00	625	655	711	662
5.01-10.00	16	19	12	12
10.01-15.00	3	4	4	6
15.00-20.00				1
20.01-25.00	1			
25.01-50.00		2	1	1
Total No.	96,735	96,623	96,793	96,694

lectures (4 units) and practicums (2 units).

The curriculum consists of the following lectures: (1) Units of radiation exposure, (2) Types of radiation exposure, (3) Biological and health effects of radiation, and (4) Radiation protection methods.

In addition, students are taught the roles of nursing personnel in radiation exposure situations in our introduction of radiological nursing course.

Our teaching staff consists of nurses, radiation technicians and specialists in radiological protection at our university.

The curriculum consists of the following practicums: (1) Measurement of natural background radiation. Through this practice students can easily understand units of radiation, for example mSv, and the scale of radiation doses, for example 2.4 mSv/yr of the natural radiation level. (2) Radiation protection techniques of external exposure. Students can easily understand the three principal methods of external exposure, which are time, distance and shield. These techniques are very useful for reducing the occupational exposure of nursing personnel during the nursing care of IVRs patients. (3) Measurement of scatter's radiation dose from a portable X-ray machine. Portable X-ray machines are frequently used in sickrooms in hospitals. Through this practicum, students acquire knowledge and skills in radiation protection through X-ray diagnosis by portable X-ray machines.

## 6. Future issues in the radiological nursing field

### 6.1. What is radiological nursing science?

Radiological Nursing Science is an interdisciplinary and practical science.

Collaboration and harmonization with other scientific fields such as radiology, radiation research, health physics, social science, psychology and education may be necessary in order to establish the field of radiological nursing science.

### 6.2. The development and establishment of a model curriculum of radiological nursing

A standard curriculum has to be developed and established quickly in order to commence the integration of radiological nursing education into the basic education system.

It is also necessary to quickly start training CNS of radiological nursing as the teaching staff of radiological nursing education in basic nursing curriculums. CNSs are required to train educators of radiological nursing and to be researchers of radiation protection in the nursing field.

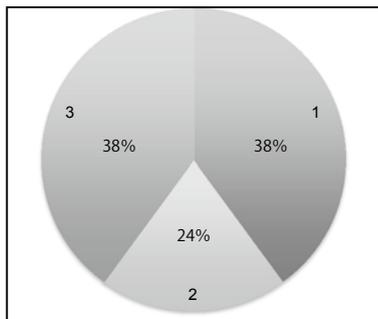
### 6.3. Who will be the radiation workers among nursing staffs?

One proposal is that only nurses working in the department of radiology in a medical institution would be designated as radiation workers, the other proposal is that all nurses working in medical institutions would be designated as radiation workers. According to Japanese regulations, all designated radiation workers included nursing staff are required to receive individual radiation monitoring, periodical special health checks, and education and training about radiological protection.

### 6.4. The dose limits for female radiation workers

At the present time, the dose limits for young women in Japanese regulations is restricted at 5 mSv per 3 months and for pregnant women at 2 mSv per pregnant period. These dose limits were established to guarantee the safety of embryos and fetuses against radiation. The embryos and fetuses in the body of female radiation workers are classified as members of the general public. The dose limits for the general public are recommended at 1 mSv per year by the ICRP.

Recently, some specialists of radiation protection in Japan have strongly asserted that it is not necessary to have special dose limits for women because the working conditions of female and male workers should be the same.



- 1: Submission of records of dose exposed at previous work place  
 2: Declaration from each worker  
 3: Doing not any action for collection of dose received at previous work place

**Fig. 1.** The methods of obtainment of exposure dose of each radiation worker received at previous radiation work place.

The real exposed dose levels of female workers are shown in Table 3<sup>9)</sup>.

Approximately 80% of all female radiation workers in Japan are members of medical institutions including physicians, nurses and technicians.

In the medical field, the exposed doses of some worker exceeded the 5 mSv per 3 months dose limit for female worker. In other fields, there were no workers exposed to doses over the dose limits.

#### 6.5. The unification of exposed dose of occupational exposure

The dose limits for radiation workers are restricted to lifetime doses. Around the world many countries have already established a unification system of occupational exposed doses. Members of medical institutions such as nursing professionals frequently transfer working places so it is difficult to estimate correct consecutive exposed doses during whole-life working periods<sup>10)</sup>.

The methods of obtainment of exposed doses received at previous radiation work places are shown in Figure. 1<sup>10)</sup>.

The main method for obtaining corrective consecutive doses was submission of records of dose exposure at previous work places. However, this method was only carried out by 38% of all institutions. Thirty-two percent of other institutions do not perform any actions for the collection of corrective exposed dose information for radiation workers.

The unification of occupational exposure is a very important issue in Japan. We strongly propose the establishment of a unification system of occupational exposure in Japan.

#### Disclosure

The author declares having no conflict of interest.

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