

THE WORK PROCESS IN RADIOLOGICAL NURSING: INVISIBILITY OF IONIZING RADIATION

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ABSTRACT: Qualitative descriptive and exploratory research, performed with 20 nursing professionals working in a general radiology unit and surgery center with the "C-arm" equipment, and the hemodynamics unit of a southern Brazilian teaching hospital. Aim was to analyze the dimensions of the work process for radiological technology nurse professionals. This paper made clear that radiological technologies are outside nursing, which leads to the invisibility of ionizing radiation, leading to inappropriate attitudes about radiological protection, which can be related to harm in professionals, caused by lack of knowledge about this issue. Among radiological nursing work process dimensions, the care dimension emerged. The necessity of implementing a continuous educational program in services which utilize radiological technologies was emphasized, thereby promoting, for patients and for nursing professionals, safer environments and integral care.

DESCRIPTORS: Nursing specialties. Radiologic technology. Radiology, interventional. Radiology department hospital.

PROCESSO DE TRABALHO NA ENFERMAGEM RADIOLÓGICA: A INVISIBILIDADE DA RADIAÇÃO IONIZANTE

RESUMO: Pesquisa qualitativa, descritiva e exploratória realizada com 20 profissionais de enfermagem que atuam nos setores de radiologia geral, centro cirúrgico com utilização de equipamento de arco em "C" e hemodinâmica de um hospital-escola do Sul do Brasil. Objetivo de analisar as dimensões do processo de trabalho dos profissionais de enfermagem que atuam com as tecnologias radiológicas. O estudo evidenciou que as tecnologias radiológicas são externas à enfermagem, induzindo à invisibilidade da radiação ionizante, o que implica em práticas incorretas de proteção, que podem se relacionar com desgastes nos trabalhadores, provocados pelo pouco conhecimento sobre o assunto. Dentre as dimensões do processo de trabalho na enfermagem radiológica, a dimensão cuidado sobressaiu-se. Aponta-se a necessidade de implantação de um programa de educação permanente nos serviços que utilizam as tecnologias radiológicas para que se proporcionem, aos pacientes e aos trabalhadores de enfermagem, ambientes mais seguros e uma assistência integral.

DESCRIPTORES: Especialidades de enfermagem. Tecnologia radiológica. Radiologia intervencionista. Serviço hospitalar de radiologia.

PROCESO DE TRABAJO EN ENFERMERÍA RADIOLÓGICA: LA INVISIBILIDAD DE LA RADIACIÓN IONIZANTE

RESUMEN: Investigación cualitativa, descriptiva y exploratoria realizada con 20 profesionales de enfermería que actúan en los sectores de radiología general, centro quirúrgico, con el equipamiento de arco en "C" y el sector de hemodinamia de un hospital-escuela al sur de Brasil. El objetivo fue analizar las dimensiones del proceso de trabajo de los profesionales de enfermería que actúan con las tecnologías radiológicas. Ese estudio evidenció que las tecnologías radiológicas son ajenas a la enfermería, lo que induce a invisibilidad de la radiación ionizante, implicando en prácticas incorrectas de protección que puede relacionarse con desgastes en los trabajadores provocados por poco conocimiento acerca del asunto. Dentro de las dimensiones del proceso de trabajo en enfermería radiológica, la dimensión cuidado sobresalió. Apúntase la necesidad de implementación de un programa de educación permanente en los servicios que utilizan las tecnologías radiológicas para que proporcionen, para los pacientes y los profesionales de enfermería, ambientes más seguros y una asistencia integral.

DESCRIPTORES: Especialidades de enfermería. Tecnología radiológica. Radiología intervencional. Servicio de radiología en hospital

INTRODUCTION

Human work should be understood as a dynamic and historical process. When analyzed from the Marxist conception, it is possible to understand human history and social relationships among individuals. In this conception, the work process is an action of human beings upon a given object, using their mental and physical abilities to transform it.¹⁻²

In the working process, man's activity performs a conscious modification of an object. The working environment is a thing, or a complex of things, that the worker places between himself and the object of work and which serves him as a conductor of his activity on that object. The use and creation of work environments characterize the work process as specifically human.¹ The appropriate activity for an aim (purpose), the work object, the workforce, and the working tool are elements of the work process.¹

Health work is essential for human life and is completed in the act of its performance, with the product being inseparable from the process that produces it.² It is a work performed by a group of specialized workers with knowledge and specific skills. The work process in healthcare is performed by several professional categories, within which nursing is inserted,² which has its operations distributed in different specialties. Among these is the radiological nursing, the focus of this study. This specialty is responsible for patient care in pre-intra- and post-procedure, involving radiological technologies. The performance of these professionals is regulated by Resolution n. 211, 1998, and the specialty is recognized by Resolutions 389/2011, for high-level professionals, and n. 418/2011, for mid-level professionals, by the *Conselho Federal de Enfermagem* - (Cofen).^{3,5}

In this study the expression, radiological technology, indicates the support services, the diagnosis and treatment of diseases using technologies resulting from the use of radiation in health, including services of medium complexity: conventional radiology, ultrasonography, computed tomography and mammography; and services classified as highly complex: nuclear medicine, magnetic resonance image and hemodynamic.⁶

Among these technologies are those that use ionizing radiation, such as: conventional radiography, computed tomography, mammography, nuclear medicine and hemodynamics. The "C-arm" equipment, used in general surgeries, such as

bile duct and urologic surgery, is also considered radiological technology. It is a fluoroscopic device (ionizing radiation emitter) and got its name for having the X-ray tube suspended by a C-shaped frame, which allows for a 360° revolution around the patient.⁷

Ionizing radiation is harmful to health and can cause deterioration, most keenly biological, of the health of occupationally exposed workers. However, nursing professionals are rarely included in personnel monitoring programs, are sometimes not addressed in specific training programs, and do not have a recognized regulatory framework as to the frequency of exposure to ionizing radiation in this work process. Although there are specific laws that relate to radiation protection, there is a lack of norms directed to frequently exposed nurses.⁸⁻⁹

Considering the complexity of the work process involving nursing professionals, at the professional and technical levels, who work in services using radiological technology, the aim of this study was to analyze the dimensions of the work process of nursing professionals active in this specialty.

METHODS

This study was outlined as qualitative, exploratory, descriptive research, conducted in a public teaching hospital located in southern Brazil. The institution has emergency services, caring for about 400 patients a day and conducting research in different areas, and also has a great demand for tests involving radiological technology, with a significant number of surgeries requiring guidance by X-ray equipment, such as the C-arm.

Survey participants were intentionally selected and the sample was composed of nursing professionals - nurses and nurse technicians, who work in the following sectors: general radiology, operating room using C-arm equipment, and the hemodynamic sector. The present study included eight nurses and 12 nurse technicians; there were 11 professionals working in the operating room, seven in the hemodynamics service, and two from the radiology sector, totaling 20 professionals. The smaller number of participants in the radiology sector is justified by the fact that the sector only has four nursing professionals - one nurse, one nurse technician, one nursing auxiliary, and one health assistant. The final number of participants surveyed was established according to the theoretical saturation.

tion of data, taking the total number of surveyed participants, regardless of sector of activity.¹⁰

For data collection, the technique of semi-structured interviews was used. The interviews followed a predetermined script, lasted an average of 20 minutes, were performed at the participants' own workplace, and were recorded and literally transcribed to maximize the reliability of the statements. After that, the interviews were presented to the participants for statement validation.

Content analysis was used for analysis of interview data,¹¹ whose focus was mainly the exploration of the set of opinions and social representations on the investigated subject. The analysis was organized into three phases: pre-analysis - by transcripts of statements and brief reading of the material; exploration of material and treatment of results - using the ATLAS software/Ti@7.0 (Qualitative Research and Solutions) when thematic units were identified; inference and interpretation - critical reading of thematic units based on the adopted theoretical framework.

In order to address the requirements of Resolution 466/2012 of the National Health Council,¹² the project was submitted for assessment and approval by the Ethics Committee on Human Research of Federal University of Santa Catarina, through the Platform Brazil, and was approved by Protocol n. 205 490 of 26 February 2013. The participants of the survey were given the Terms of Free and Informed Consent, which explains the research context, the ethical responsibility of the researcher, the risks and benefits of participating in the study. To guarantee the anonymity of participants, an alphanumeric code to identify respondents were used. The letter "E" followed by a number in ascending order (E1, E2, E3, E4, ...) was used to refer to nurse and the letter "T" followed by a number in ascending order (T1, T2, T3, ...), for nurse technician.

RESULTS AND DISCUSSION

The results presented below correspond to the analysis of interviews of the nursing professionals, discussed in two categories: the working process of radiological nursing and dimensions of the working process in radiological nursing.

Working process in radiological nursing

The result of nursing work, which is characterized by care, presupposes an interaction

between those who perform the work and those who receive it and, somehow, it is transformed.¹³⁻¹⁴

The purpose of the radiological nursing working process of the studied service is the care of patients undergoing any type of procedure involving radiological technologies. This provision of care can have different arrangements when related to the sector of action. In the radiology sector, the purpose is obtaining images that will help with the accurate diagnosis of patients.¹⁵ In the operating room, the purpose is to obtain images that will drive or facilitate some therapeutic procedure. And, in hemodynamic areas, there are different purposes which can be used both for diagnosis and treatment of disease.

Associating the analyzed working process in radiology services, operating room and hemodynamic areas with the interviews enables the realization that the patient, who receives the care, is the object of work. Transforming the discomfort or pain status of the patient into a painless state of well-being rests with the nurses.¹⁶ It is also the role of radiological nurses to attend investigative processes such as diagnostic tests, for example, to assist in changing that object (the patient), assuming a key role in reassuring patients about examinations and treatment; clarifying the radiation of that procedure, and also caring for the radiological protection of patients. But based on the staff statements about radiological technology as a work tool, it is not perceived by these workers. When questioned about their routine, technical procedures they perform with the patient was the most common observation, ignoring the fact that ionizing radiation is present in their daily work. This situation can be seen in the following statement: *My work routine consists in coming up in the morning; we have a work schedule; there is scrub day or circulating day. In my circulating day, I provide all anesthesia material, which are the refrigerated medications, medications, warm up the saline solution and wait for the patient. Helping the anesthesiologist and preparing the patient for surgery are among my tasks in the operating room. Placing the electrodes, pulse oximeter, blood pressure device, positioning the leg, ensuring that the patients is comfortable, warmed, and helping the scrub nurse with some materials.*

Ionizing radiation has invisibility in the working process, primarily because it is a working tool for activities that are collectively performed by nursing professionals, physicians and radiological technicians; there is a tendency to transfer responsibility for that advice to the next, regardless of

their training. Namely, "if the work is something external to the worker, it is not part of his nature [...], he is alienated"^{17:35}.

This attitude can be justified by the poor knowledge of nursing professionals about radiological technologies and the risks of exposure to ionizing radiation. In one of the statements it was clear that, for admission to this service the specific knowledge related to radiological technology is not important, but rather, the technical nature of the professional knowledge, which is specific and inherent in nursing practice. Most professionals do not choose the activity sector in which they working.

Professionals who come here must have surgical instrumentation formation, because in an endoprosthesis he will have provide the instruments; in an angiography he will have to provide the instruments (E2).

It is the physician who does that. The equipment is being handled by the physician; it is not us (E3).

What do I consider as specific knowledge of radiology? I am not concerned about that, I do not analyze an X-ray (E1).

These statements express the appreciation of general technical knowledge of the area, represented by nursing techniques and routines; at the same time they leave an impression of a lack of professional responsibility with this reality. Scientific knowledge must be available for the professional; this relationship should be mediated by the employer, providing conditions to confront and solve everyday situations through integrated actions with the multidisciplinary team.¹⁸

Many statements identified as consequences showed concern regarding professional burnout as a result of working environments. Burnout is understood as negative changes resulting from the action of the loads on the human body.⁹ So, stresses are related to discomfort during procedures, resulting from Personal Protective Equipment (PPE) use, its weight (it can weigh between seven to ten kilos), and the period during which these professionals use such equipment.

One important thing is the apron weight. It is an ergonomic risk. I had an injury to my left shoulder because I'm small and the vests are beyond my weight. We have some vests weighing five and seven kilos. With the shoulder support, there is a skirt too, but it is too heavy. There was a time, days of working from seven in the morning to seven, eight at night. The days I worked many hours there, I had aching joints (E6).

It is the weight of the lead apron; the vest is very exhausting and also because our staff is already of an advanced age and we are so sorry when they need to use it. Everything is heavy. You want the surgery to end... I am no longer small, then carrying another ten kilos, I do not know how much it weighs, but it should be close to that. So it's very tiring. There are people who have pain the next day, it is so heavy (T8).

Reflecting on staff statements, and relating it to the fact that ionizing radiation is an invisible working tool during the work process for them, demonstrated that the weakness in specific knowledge of ionizing radiation can generate attitudes that enhance or that do not prevent risks and stresses inherent to the work of radiological nursing.¹³

These professionals must know the benefits but also the risks of ionizing radiation exposure and, thus, learn to protect themselves from unnecessary exposure by using specific protective equipment or even the inverse square of the distance factor*.¹⁹ It is important that staff have knowledge of the ALARA principle** and the 10 day rule*** as a way to protect themselves from ionizing radiation exposure.

The domain of this knowledge was not explicit during interviews. The ALARA principle implies a reduction of administered doses to patients. This means that special attention should be given to each medical and consequently, occupational, exposure.²⁰

When questioned about actions adopted for radiological protection in their working process, the respondents referred to using the lead apron and thyroid shield as protective devices. Radia-

* Also known as, Law of Attenuation. The intensity of radiation emitted by a source decreases with the square of the distance ($R=I/d^2$ where I is the intensity of the radiation corresponding to the distance, d , from the source).

** This principle states that occupational exposure should be kept "As low as reasonably achievable" (the lowest possible level).

*** Recommended by the International Commission on Radiological Protection (ICRP). It states that all radiological examinations of the pelvis and lower abdomen must be marked during the first ten days after the onset of menstruation.

tion safety glasses, despite being present in the surveyed sectors, were identified as PPE that caused a lot of discomfort and were not being used, particularly in operating room and radiology areas. There was a greater awareness of the PPE use in the hemodynamic sector. The PPE use during exposure to ionizing radiation is the most effective, simple and inexpensive way to protect patients and occupationally exposed individuals.²¹

When questioned about PPE used, staff related the use of dosimeter as a protection against radiation, which in reality represents a distorted view, since it does not protect against radiation. The dosimeter monitors the amount of radiation received during the exposure period. According to Order n. 453 of the Ministry of Health, June 1, 1998, establishing the basic requirements of radiation protection in diagnostic radiology, all staff who perform activities with diagnostic X-rays must use, throughout their workday, an individual dosimeter indirect reading, which must be exchanged monthly.²² The following statements illustrate this finding: *they use the apron, the neck protector, but the dosimeter is always a controversy. In the beginning, when the C-arm arrived, a fight started because of the radiation protection needed for that, a lot of work because of that. Enough fight for having a dosimeter to monitor the employee, but now it is not been used! They do not use the dosimeter. We bring it to their attention, Hi, you have to use the dosimeter! We can see where the dosimeters are, the dashboard, some of which were not used* (E5).

Because we use the dosimeter just to prevent (T1).

The apron, thyroid protection, and the dosimeter... Sometimes we use glasses; the glasses should be a lighter thing. They are heavy and when we are handling instruments, we have to be careful that they do not fall on the table, on the patient (T7).

The staff's statements indicate that not all attitudes for radiation protection are completely adopted in all sectors. In most cases, the PPE are used because it is standardized practice, but is not always done consciously. The Cofen Resolution n. 211/1998 determines that it is one of the nurse's responsibilities to respect and enforce the rules, regulations and legislation relevant to this area of work, a point that appears as fragility in the environments studied.³ In addition, other protective practices could be employed, such as compliance with the exposure time and distance, not always known by staff. This ignorance was found especially in the operating room, where the invisibility of ionizing radiation practice is more evident.

The deficit in the hospital workforce, mainly in the hemodynamics and radiology sectors, were evident in the interviews with the head nurses. The shortage of these staff implies a rhythm of more intense work, thus increasing their possibilities for injuries.

We do not have enough nurses in the morning; there are three, of which one is in contrast exams, one in ultrasound and one in tomography. In the afternoon, we have a professional in the tomography sector (E1).

Today, we have one nurse in the morning and one in the afternoon. We are always counting on three to be able to realize it. Throughout the procedure we have contact with this radiation. [...] The ICU needs to understand that when the exam is over I have to send the patient back, because I do not have personnel or enough space for the next patient. [...] The staff is not provided. And the hospital is undergoing a major functional crisis. [...] We need one staff in the morning, one in the afternoon and until eleven o'clock at night (E2).

Studies²³⁻²⁵ indicate that having the appropriate number of nursing staff is a relevant factor for safety and quality of patient care, especially in radiological nursing.

Dimensions of the working process in radiological nursing

Nursing work incorporates elements of the work process in a capitalist society, in addition to specificities of the health area. In this context, radiological nursing also is characterized as a complex role that performs four inseparable basic actions: caring, educating, management, and research.¹⁷ These dimensions were identified in the working process of the area studied.

The caring dimension refers to direct care of the individual; it is the identifier of the profession and has as its purpose the maintenance of health for individuals, families, social groups and communities.^{17,26-27} The working process in radiation nursing is evident when professionals report actions they perform in their routine, demonstrating that care permeates the actions of guidance, welcoming, direct patient care during and after procedure: *We go to the patient unit, perform a pre-visit, monitor during the procedure, and after the procedure he leaves with documentation and a post-intervention care plan. One of our functions is to identify the length of exposure to radiation; the patient who is exposed for more than 20 minutes must be referred to the dermatology clinic, which will be monitored by dermatology* (E2).

So, in some cases, patients are exposed to ionizing radiation for a time greater than 20 minutes. This is a troubling fact, as biological effects of radiation absorbed depend on the dose and rate of exposure of the exposure manner. The greater this rate, the greater the likelihood of damage, mutations, cell death, among other biological effects.²²

Another dimension of the radiological nursing working process is education. It is characterized as a different process, because it includes professional training, health education and continuing education. The purpose is the collective and individual transformation of health.^{17,27} The next lines clarify this dimension of work: *We do not provide guidance with respect to ionizing radiation [...] unfortunately, I apologize because patients should be advised not to enter into the sector. In daily radiology, tomography, the patient is placed in the tube, we make sure to guide rather the effects of contrast* (E1).

I guide the residents, staff and students on specific activities involving radiological technologies, for using radiation protectors and bracelets that measure the amount of radiation (E8).

The statements show that the education dimension is limited in relation to health education, especially, in radiology and the operating room, where there is no clear guidance provided for patients who undergo radiological procedures. It is necessary to consider the fact that the nursing consultation enables and should investigate all information about the patient and thus provide for the development of a more individualized care plan, including health education activities.²⁸

The education dimension in radiological nursing is related to the care of others and care of oneself, namely, it involves health education and continuing education, a dimension of the working process which aims to increase the quality and safety of care. According to the respondents of the survey, this need is manifested mainly when the professional enters the sector, as follows: *I studied on my own, I was interested to know the types of radiation existing in hemodynamics, I studied because I was interested. [...] I learned I prepared myself; today I am prepared for everything* (E4).

She referred me to a book that exists with pictures, written a long time ago; at the time it was already not current, but I got this book. I read that book and began to interact with the people from here (E1).

In this manner, the search for a continuous educational process should permeate the practice of the nursing radiation professional, which creates a bond with patients, as his time next to the

patient is greater than any other professional of the multidisciplinary team of this sector.

Management was another dimension analyzed in the radiological nursing working process. It is management, coordination and organization of nursing work and the assistance provided by staff. This dimension of the nursing working process aims to develop appropriate and safe conditions for caring, so it is common to refer to this process of work as indirect care.^{17,26-27}

Radiological nursing actions related to the management dimension, include: appropriate staffing and organization of the workforce, sector dynamics of the organization, provision and acquisition of materials and medicines, among other activities. The statement below demonstrates the management dimension: *My routine is to coordinate the operating rooms, arrival to and departure from surgery; we have to be attentive to the amount of nursing staff, the amount of anesthesia procedures, because we cannot put the patient in the room without anesthesiologist. We coordinate the operating room. This is the dynamic, the logistics. We have to check if there is enough material. That's all day long, coordinating both elective surgeries as well as urgent and emergent* (E5).

The Cofen Resolution n. 211/1998 establishes as one of the nurse's competence in radiological nursing "planning, organizing, supervising, executing and evaluating all nursing activities performed for clients undergoing ionizing radiation, grounded in nursing care methodology".^{3,4}

Finally, the last dimension of the radiological nursing working process addressed in this study is the research dimension. It refers to the production of knowledge that will guide and support all nursing practices, which enables the understanding and modification of the work of these professionals.²⁶⁻²⁷

The analysis of these work processes allowed the finding that this dimension is not explicit in radiological nursing practice. The statements of respondents did not mention it. But, it is an important dimension of the radiological nursing working process, as the production of new knowledge through research can be used as a tool for safe activities related to ionizing radiation exposure.

FINAL CONSIDERATIONS

The analysis of the working process in radiological nursing identifies that the use of radiological technologies in the radiology, hemodynamic and operating room sectors is seen as a working

tool that is external to the nursing working process. This invisibility of work in radiological nursing may be related to the stresses on staff caused as a result of lack of knowledge on the subject, resulting in incorrect protective practices. Thus, compliance with Resolution Cofen n. 211, 1998 and the constant qualification of the workforce are strong allies for reducing the burnout caused in this environment. In addition, it is essential to know and apply other protective measures, such as time and distance, beyond the use of individual protective equipment.

The conclusion is that the dimensions of the working process in radiological nursing relate to each other, often occurring simultaneously to the provision of care, confirming the complexity of nursing practice. The caring dimension emerged in the statement of subjects, confirming that the identifying dimension of the profession is caring. Education and research dimensions appear discreetly in the environments studied, which raises concern, since these two dimensions provide the foundation necessary for working in radiological nursing.

The specific attributions of professional nursing in working processes with radiological technology must comply with the level of complexity determined by professional nursing legislation. These should be formally designated, described and disseminated in recognized protocols.

"Ionizing radiation" is a frequently disregarded subject in the education of nurses and nurse technicians. So, it is urgent to establish a permanent education program in services that use radiological technologies, to enable the offering of safe and comprehensive care for patients and professional environments.

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