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Reality of radiological examinations with patients with physical limitations

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Abstract: This article discusses the problems faced in daily hospital and clinical practice in Brazil, where there are no examination protocols or bibliographies that professionals can use as a basis for performing radiological examinations on patients with movement limitations and clinical conditions, such as paraplegia and tetraplegia. The objective of this study was to develop a booklet of adaptations of radiological positions for patients with reduced mobility. This material can improve and optimize the services provided in the area, offering greater radiological safety to both the professional and the patient during the examinations. The methodology used involved national bibliographic reviews, technical visits and hospital monitoring, as well as discussions with professionals specialized in the area of radiology, in order to consolidate a more concrete and specific basis for the studied content. Based on these data, it was possible to formalize a simplified booklet, in Portuguese and English versions, accessed through specific QR Codes. The booklet includes some adaptations of radiological examination positions for patients with physical limitations or reduced mobility. The booklet contains a didactic structure for quick consultation to better guide the professional regarding the performance of the examinations. It contains a cover, a presentation, a summary, an introduction, a summary of conventional exams, the adaptation of exams, the conclusion and finally the references. The conclusion of the study emphasizes the importance of expanding research aimed at adapting radiological exams for patients with physical limitations or reduced mobility. These adaptations aim not only at the well-being of the patient, but also at the health, radiological protection and ergonomic safety of professionals, avoiding injuries during the conduct of the exam or its repetition. It is hoped that this material can provide a more humanized environment for both patients and professionals.

Keywords: Adaptations of radiological exams for patients with reduced mobility, Conventional radiology, Patients with physical limitations, Booklet for patients with physical limitations.

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Realidade dos exames radiológicos com pacientes com limitações físicas

Resumo: Este artigo aborda os problemas enfrentados na prática hospitalar e clínica diária no Brasil, onde não há protocolos de exames ou bibliografias que os profissionais possam utilizar como base para a realização de exames radiológicos em pacientes com limitações de movimento e condições clínicas, como paraplegia e tetraplegia. O objetivo deste estudo foi desenvolver uma cartilha de adaptações de posições radiológicas para pacientes com mobilidade reduzida. Este material pode melhorar e otimizar os serviços prestados na área, oferecendo maior segurança radiológica tanto ao profissional quanto ao paciente durante a realização dos exames. A metodologia utilizada envolveu revisões bibliográficas nacionais, visitas técnicas e acompanhamento hospitalar, além de discussões com profissionais especialistas na área de radiologia, a fim de consolidar uma base mais concreta e específica para o conteúdo estudado. A partir desses dados, foi possível formalizar uma cartilha simplificada, nas versões em português e inglês, acessada por meio de QR Codes específicos. A cartilha contempla algumas adaptações de posições de exames radiológicos para pacientes com limitações físicas ou mobilidade reduzida. A cartilha contém uma estrutura didática para consulta rápida para melhor orientar o profissional quanto à realização dos exames. Contém capa, apresentação, resumo, introdução, resumo de exames convencionais, adaptação de exames, conclusão e, por fim, as referências bibliográficas. A conclusão do estudo ressalta a importância da ampliação de pesquisas voltadas à adaptação de exames radiológicos para pacientes com limitações físicas ou mobilidade reduzida. Essas adaptações visam não somente o bem-estar do paciente, mas também a saúde, a proteção radiológica e a segurança ergonômica dos profissionais, evitando lesões durante a realização do exame ou sua repetição. Espera-se que este material possa proporcionar um ambiente mais humanizado tanto para pacientes quanto para profissionais.

Palavras-Chave: Adaptações de exames radiológicos para pacientes com mobilidade reduzida, Radiologia convencional, Pacientes com limitações físicas, Cartilha para pacientes com limitações físicas.

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1. INTRODUCTION

When addressing the risks present in hospital and clinical environments, it is necessary to include all people involved: patients, companions, visitors and clinical staff. An accident in the workplace can happen at any time and to anyone, and can cause countless losses and consequences. Therefore, it is up to health professionals to ensure the safety and well-being of patients. The World Health Organization defines this safety that professionals must have with patients as reducing to an acceptable minimum the risks of harm associated with patient care, that is, the risk is the possibility of an accident occurring. An example would be a patient' drop of level at the hospital [1].

Regarding the CNEN Standard NN 3.01, CNEN Resolution 323/24, April / 2024, in section V, item entitled Public Exposure, it is recommended in Art. 73 that when applying the principle of optimizing radiation protection, in all phases of the life cycle of the installation or activity, the following aspects must be considered: I - possible changes in any conditions that may affect public exposure; II - good practices in the operation of similar sources or in the conduct of similar activities; III - uncertainties in the assessment of doses [2].

According to the Resolution of the Collegiate Board (RDC No. 611, of March 9, 2022), in Subitem I, General principles of radiological protection, Art. 43, it is established that all procedures performed in diagnostic or interventional radiology services must observe the principles of justification, optimization, dose limitation and accident prevention. This ensures that the patient's exposure to the risks inherent to each technology will be the minimum necessary to ensure their integrity, as well as the quality of the images and procedures. Art. 44 of the aforementioned resolution establishes that the medical exposures of patients must be optimized to the minimum value necessary to achieve the radiological objective, as well as be compatible with acceptable image quality standards. The following recommendations should be followed: correct selection of techniques, equipment and

accessories, work processes, quality assurance, appropriate diagnostic reference levels for pediatric and adult patients, dose restrictions for individuals who collaborate consciously, of their own free will, in the humanization and comfort of a patient, during the performance of the radiological procedure [3].

Technological advances have improved and made various sectors of society, including the health sector, more practical. More specifically, in the medical radiology sector, it is possible to observe the improvements that technology has provided, greatly optimizing the service and also improving the quality of the images acquired. Research indicates that most radiology technicians and technologists consider technology to be a fundamental tool [4].

However, even with technology optimizing the work of radiology professionals, they still face some difficulties. The biggest of which is adapting the positioning of patients with limited movement or with specific clinical conditions in conventional radiology exams. Positioning is defined as the study of the position in which the patient should remain while undergoing the radiological exam [5].

Radiological positioning is mainly followed in accordance with the "Handbook of Radiographic Positioning and Techniques", written by Kenneth L. Bontrager and John P. Lampignano, available in several editions. These authors present, in a didactic manner, practical methods and procedures for performing various radiological examinations [6].

Most exam positions are designed for cooperative patients who are able to remain in the position determined by themselves. However, some patients are unable to perform exams without the help of another person, present in the room, or adaptation of some support. Given this scenario, different adaptations are necessary for the exams performed. Some professionals, according to their professional experience, provide practical strategies for performing exams on patients with some type of limitation or reduced mobility. This initiative by professionals means that the different positions of patients who have some kind of limitation are performed following the same protocol as those who do not have it. If there

are no different procedures for patients who have some kind of limitation, the quality of the images may be compromised, resulting in the risk of new exposures and unsafe reports [7].

The lack of a positioning protocol for patients with physical limitations or reduced mobility can lead to even more serious consequences than those already mentioned, as it may result in physical injury to the patient, a patient' drop of level or an accident in the room. This is due to the fact that many professionals choose to perform exams on the table with the patient lying down, as they believe that this is the only way to perform the exam.

Studies show that nurses and other professionals are more susceptible to spinal injuries resulting from handling and transporting patients [8]. One type of injury would be musculoskeletal injuries. Such injuries are a public health concern and also the most worrying for the health of workers [9]. The most common occupational risks for the radiology professionals are those related to the work environment and ergonomic details, such as lifting a heavy patient and assisting others with physical limitations or reduced mobility. In addition to these issues, there is the intense work routine of professionals, working with equipment that demands high attention and the pressure for team productivity, especially in a reality of constant emergencies and urgencies [10].

During the internship period in clinics and hospitals in the city of Curitiba, state of Paraná, Brazil, professionals who performed radiological examinations were observed, and it was found that approximately 60% of the technicians who worked in the hospitals reported having suffered some injury to the spinal column during their professional activities, mainly due to the transfer of patients to the examination table. It was also noted that adaptation of patient positioning was possible in approximately 80% of the examinations performed in one of the large hospitals in Curitiba, where monitoring was possible. These data inspired the development of the booklet on adaptation of positioning for patients with reduced mobility.

Therefore, there is an imminent need to present a protocol, guide or manual for performing examinations on patients with physical limitations or reduced mobility, specifically with paraplegia, since this type of limitation has become frequent. Studies by the

IBGE (Brazilian Institute of Geography and Statistics) indicate that approximately 3.4% of the population has difficulty walking or climbing steps, presenting some mobility limitations. In addition, the growth of the elderly population also requires greater caution when positioning patients for radiological examinations [11].

The use of ionizing radiation in radiological examinations causes the radiation to interact with human tissue and can generate biological effects, making the use of radiological protection equipment vital. This equipment aims to reduce patient exposure, ensuring greater protection and minimizing the areas of the body that are exposed. Therefore, Personal and Collective Protective Equipment in radiology is essential to ensure the safety of not only the patient, but also of professionals and possible companions [12].

The objective of this study was to develop a guide for adapting radiological positioning for patients with reduced mobility. This need was felt by one of the authors of this article, since a family member of his is a wheelchair user. This material could improve and optimize the services provided in the area, providing a literary base for professionals and greater safety in the execution of radiology exams, avoiding repetitions and unnecessary exposure of patients.

2. MATERIALS AND METHODS

The methodology used was based mainly on practical internships carried out over the course of a year in hospitals and clinics in the metropolitan region and the capital of Curitiba, state of Paraná, Brazil, where (i) access to the method of performing the exams was obtained, (ii) ideas were exchanged with radiology technicians on how to perform the images for patients with limitations. Monitoring was carried out through in-person observation, in which there was a high average of patients with reduced mobility, including elderly patients, those with physical disabilities and other conditions that made it difficult for the patient to move during the exam.

The presence of paraplegic and elderly patients was particularly noticeable, especially in the morning shift, when an average of approximately ten patients per day with some limitation of movement or special condition were seen. Based on this scenario, observing the routine of professionals in relation to the measures and adaptations necessary for patients with physical limitations or reduced mobility, a selection of articles was developed in the Virtual Health Library. The objective of this research was to seek literary enrichment on the subject through Brazilian articles and theses, using the following keywords: adaptations, radiological examinations, paraplegia and patients with physical limitations or reduced mobility.

Examinations of paraplegic, tetraplegic, cerebral palsy and joint injury-related patients were monitored. However, the scope of the study was restricted to patients with paraplegia, considering the higher incidence of these patients in hospitals and clinics. This was done to assess the best way to position them, allowing a satisfactory radiographic projection for the medical report, in addition to promoting the radiological protection of the patient and avoiding unnecessary movements that could compromise the physical integrity of the occupationally exposed individual and patient.

To develop the positioning guide for patients with paraplegia, projections of the anatomical areas of the thorax, foot, knee, shoulder and pelvis were selected. The focus of the guide was restricted to the routine examinations most frequently observed in hospital practice, namely: posteroanterior (PA) and lateral views of the thorax, PA and oblique views of the anatomy of the foot, anteroposterior (AP) views of the pelvis, AP and lateral views of the shoulder and AP and lateral views of the knees. Once the radiological examinations were defined, the collected material was filtered, selecting certain adaptations made by professionals in radiological techniques. Each examination was developed with two views.

For the graphic arts, the Samsung Notes application was used, so that it was possible to sketch freehand drawings of the images referring to the adaptations of the positions, maintaining the correct technique for the exams. The arts highlighted certain anatomical

positions, prioritizing lateral, anterior and posterior observations of the studied areas. This way, a better understanding and greater wealth of details were ensured. However, real measurements of human anatomy were not used, so it was necessary to consider a margin of disproportionality between the drawn objects.

3. RESULTS AND DISCUSSIONS

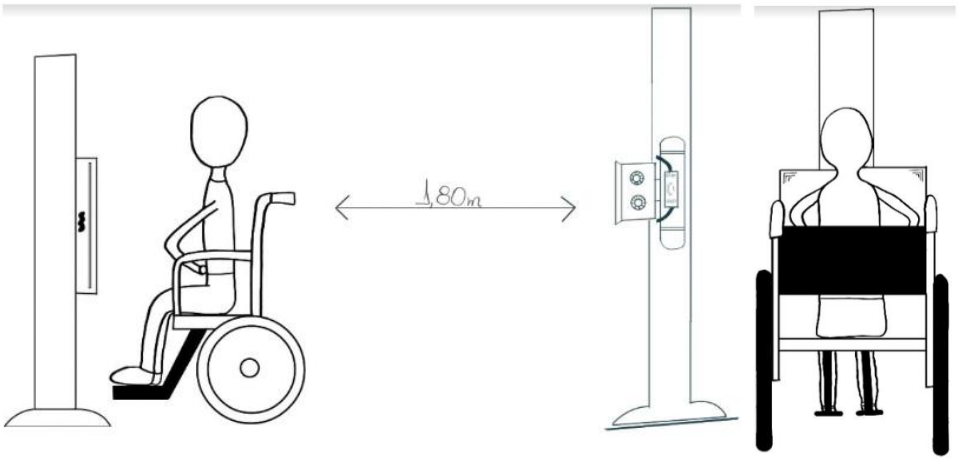
A theoretical framework was developed through articles, which supported the initial preparation of the booklet. Through data collected in hospitals and clinics in Curitiba/Paraná, it was possible to identify that even though there was no official protocol for adaptations, most technicians ended up using their own adaptation or one passed on by other professionals of radiological techniques. Thus, even with discrepancies between adaptations, types of exams and physical conditions of the patient, it was noted that in the daily routine of radiology professionals, the adaptation of exams for patients with limitations or specific clinical conditions is a reality.

It was evident that searches in the Virtual Health Library, based on articles, dissertations and theses, on protocols for patients with limitations, did not find specific materials on the adaptation of radiological exams. This fact reinforces the importance of developing studies in Brazil aimed at the care of patients with physical limitations. All procedures performed in diagnostic radiology services must observe the principles of justification, optimization, dose limitation and accident prevention, in accordance with RDC Nº 611 (2022) [3]. In this way, it can be ensured that patient exposure to the risks associated with new technologies will be minimal, guaranteeing patient safety as well as the quality of images and procedures. This panorama motivated the development of the educational booklet presented in this work.

Fig. 1 depicts the adaptation of the positioning of the chest exam in patients with a small anatomical structure, that is, patients with an ectomorphic body type, presenting a

narrow and elongated body structure, which allows the exam to be performed in the wheelchair itself. Thus, it is possible to visualize the patient's positioning in relation to the mural Bucky both in the lateral view, on the left, and in the posterior view, on the right.

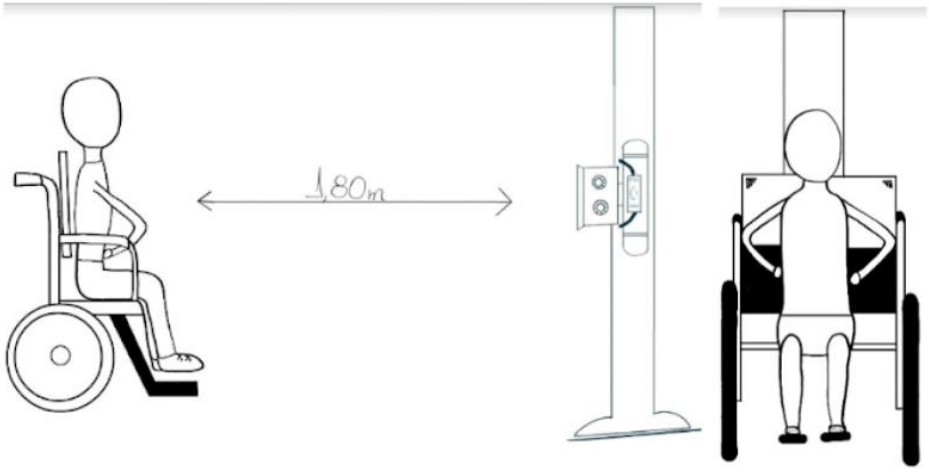
Figure 1: Adapting patient positioning in posteroanterior chest examination



Source: Own authorship adapted [6].

Fig. 2 shows the adaptation of the positioning of the chest exam in patients with a large anatomical structure, that is, patients with an endomorphic body type, with a wide and shortened body structure, which does not allow the exam to be performed in the wheelchair itself, since the anatomical structure of these patients would be overlapped by the metal bars of the wheelchair. Thus, it is possible to perform the exam with another adaptation technique, placing a chassis between the wheelchair and the patient's vertebral spine, avoiding the overlapping of the anatomical structure analyzed with the metal bars of the wheelchair. In this way, it is possible to visualize the positioning of the patient, with the adaptation previously exposed, observing the position of the chassis and the patient both in the lateral view, on the left, and in the anterior view, on the right.

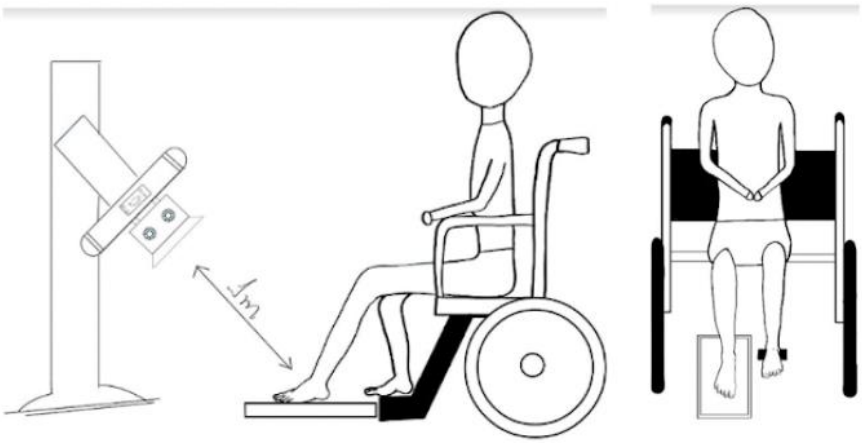
Figure 2: Adapting patient positioning in anteroposterior chest examination



Source: Own authorship adapted [6].

Fig. 3 shows the adaptation of the positioning of the anteroposterior examination of the anatomy of the foot in patients with paraplegia or reduced physical mobility, where the possibility of performing the examination with the patient in his/her own wheelchair is exposed, avoiding the patient's movement and bringing the X-ray equipment closer to the region of interest and positioning a chassis underneath the part that will be exposed, increasing the speed of the examination and ensuring greater safety for the patient. In this way, it is possible to visualize the positioning of the patient, with the adaptation previously exposed, observing the position of the chassis in the region of the anatomy of the foot and the patient both in the lateral view, on the left, and in the anterior view, on the right.

Figure 3: Adaptation of patient positioning in the anteroposterior examination of foot anatomy

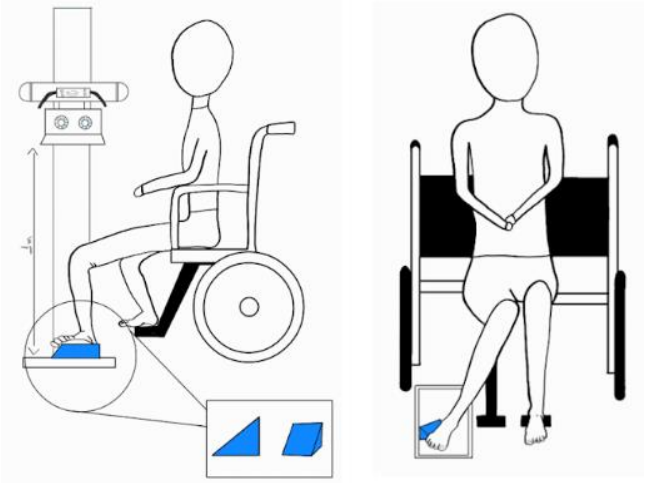


Source: Own authorship adapted [6].

Fig. 4 shows the adaptation of the positioning of the oblique examination of the anatomy of the foot in patients with paraplegia or reduced mobility, where it is feasible to perform the examination with the patient in the wheelchair, avoiding the patient's movement and bringing the X-ray equipment closer to the region of interest and positioning a chassis underneath the part that will be exposed, increasing the speed of the examination and ensuring greater safety for the patient. Therefore, it is possible to visualize the positioning of the patient, with the adaptation previously shown, observing the position of the chassis in the region of the foot and the patient both in the lateral view, on the left, and in the anterior view, on the right. It is also possible to note the use of triangular cushions to support the lower limb at the correct angle, as indicated in the book by the author Bontrager [6].

It was possible to formalize a simplified booklet, in Portuguese and English versions, accessed through specific QR Codes. The booklet has a total of 28 pages in both the Portuguese and English versions, with 20 digital drawings referring to suggestions for positioning adaptations for patients with reduced mobility. These 20 drawings contain graphic representations of the 20 positions that could be used adaptively, proposing the modification of the patient's positioning in a more practical way.

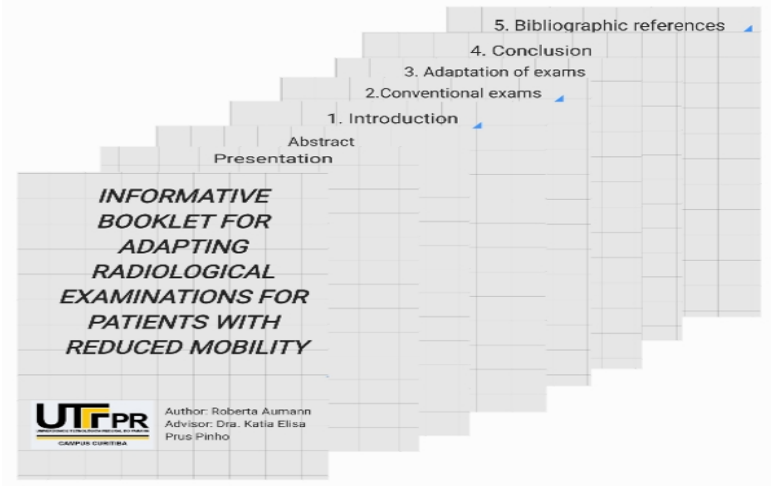
Figure 4: Adaptation of patient positioning in oblique examination of foot anatomy



Source: Own authorship adapted [6].

The booklet contains a didactic structure that presents, in a sequential and strategic manner, a cover, a presentation, a summary, an introduction, a summary of conventional clinicals exams, the adaptation of the clinicals exams, the conclusion and, finally, the references. The design of the booklet was proposed with a neutral and more formal color, highlighting the content and avoiding visual pollution. Emphasis was placed on the content presented in an objective and simple way, as can be seen in Fig. 5.

Figure 5: Structure of the booklet



Source: Own authorship.

To better disseminate the material, it is available in digital format, in Portuguese and English. This allows easy access anywhere, at any time, and for all interested professionals. To this end, two QR Codes were created, one associated with the booklet in Portuguese and the other in English. Fig. 6(a) shows the QR Code for accessing the booklet prepared in Portuguese and Fig. 6(b) the QR Code for accessing it in English. These QR Codes can be displayed in examination rooms or distributed to professionals in the field of radiology, allowing quick access to the material. In this way, before or during the radiological examination, doubts can be clarified, in addition to promoting the physical and radiological protection of the patient and allowing a safer and more peaceful examination for the professional.

Figure 6: (a) QR code to access the booklet in Portuguese, (b) QR code to access the booklet in English

Source: Own authorship.

The booklet prepared is the initial milestone to encourage professionals to conduct further studies on the problem highlighted. Therefore, it presents around ten suggestions for positioning adjustments for patients with limitations. The adjustments were presented in an illustrative manner to facilitate better understanding, presenting more than one view to encompass more details, in addition to briefly including some instructions that professionals should evaluate before the examination.

4. CONCLUSIONS

Based on the monitoring and research carried out, a large gap was observed in the Brazilian national literature. This is a point that indicates that radiology technicians did not have any reference material or guidance regarding procedures with patients who have clinical conditions with movement limitations or reduced mobility. Considering the increase in life expectancy of the world population over the years, the topic discussed in this work only emphasizes the need to expand research and studies focused on exam adaptations. Therefore, they require special treatment and also an exam that meets and captures what is necessary for a good diagnosis [3].

In the area of radiology, it is difficult to implement adaptations, since incorrect positioning can hinder the execution of the exam, the report and the treatment of the patient,

in addition to the risk of unnecessary exposure of the patient and occupationally exposed individuals. The fact that no protocols were found in Portuguese for radiological positioning of patients with movement limitations, especially highly recurrent clinical conditions such as paraplegia and tetraplegia, indicates the need for changes and demands more research focused on this topic. In the future, this material may be improved based on contributions from the experiences of other professionals, as well as translated into languages other than English. The dissemination of this material may expand the culture of protection of patients and occupationally exposed individuals, both ergonomically and biologically, in relation to the harmful effects of ionizing radiation. It is expected that this material may provide a more humanized environment for both patients and professionals.

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CONFLICT OF INTEREST

All authors declare that they have no conflicts of interest.

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