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The evolution and future prospects of ionizing radiation protection training for dentists in Taiwan

KEYWORDS
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After the World War II, the international community conducted profound reflection on the peaceful use of atomic energy. The postwar Taiwan government established the Atomic Energy Council (AEC) in 1955 to oversee the development of atomic energy technology and the safety regulation of its peaceful uses, including the safety regulation of ionizing radiation in dentistry. Then, in 1968, the Atomic Energy Law was formulated as the legal source of radiation protection. In 1973, the Regulations for Medical Ionizing Radiation formally required dentists to undergo medical ionizing radiation protection training before applying for a radiology diagnosis equipment operating license. This led to the development of a special system of radiology diagnosis equipment operating license for dentists. Therefore, a system specifically called radiation protection training for dentists (RPTD) has been in operation in Taiwan for over 50 years. In 2002, the Ionizing Radiation Protection Act (IRPA) was enacted and promulgated, becoming a new legal source of radiation protection. The AEC was reorganized into the Nuclear Safety Commission (NSC) in 2023, continuing to serve as the competent authority for this system.[1] In this article, the interviews were used to explore the evolution and future prospects of this specialized radiation protection training system for dentists in Taiwan.

This study used purposeful sampling to interview two medical radiation technologists (MRTs) with experience in RPTD teaching. One was a retired MRT who served as a teaching assistant for the AEC-administrated RPTD program in the 1980s. The other was a current MRT who has regularly taught the courses for the RPTD program since the 2000s. The interview outline focused on the RPTD teaching methods and course content, as well as the future prospects for the RPTD in Taiwan.

Our interviews revealed the following findings. In the early days (at least during the 1980s), the participants in the AEC-administrated RPTD program were all practicing dentists. They participated in the RPTD program to obtain an operating license for the dental X-ray machines. Moreover, the dental clinic operators also required this operating license to legally purchase and own the dental X-ray machines. The RPTD program consisted of a three-day course, including two and a half days of lectures, and a half-day of internship course. The lectures focused on dental radiation protection, presented by a dental professor. Other topics, such as radiation principles, radiation protection, and characteristics of various radiations, were presented by the professors and experts of atomic energy. The internship course was conducted in the dental X-ray room of National Taiwan University Hospital (NTUH). The trainees would learn to operate various dental X-ray equipment for taking the periapical, panoramic, and cephalometric radiographs, as well as learn to process the

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X-ray films using the automatic film developing machine or using the traditional darkroom development technique, including 5 main steps such as developing, washing, fixing, washing, and drying. Then, they would receive a certificate of completing the RPTD when accomplishing the course and passing the examination.

However, in dentistry, the 2002 IRPA relaxed regulations for radiation protection. The new regulatory system no longer distinguishes between medical and non-medical uses. Furthermore, a medical exposure radiation dose comparison chart published by the AEC in 2010 shows that taking a periapical radiograph needs the lowest radiation dose among all types of medical imaging (Fig. 1). Because the dental X-ray equipment has a nominal voltage below 150 kV, it falls under the minimum regulated level. The dentists only need to complete the 18-h radiation protection training course prescribed by the competent authority to qualify for operating the dental X-ray machines. This training is authorized to be offered by the dental schools, academic institutions, civil organizations, or private companies. Therefore, there is no longer an AEC-administrated RPTD program. The dental students no longer need to wait until they become dentists to receive this training. The RPTD program now refers to a radiation protection training course arranged by the dental schools, either directly offered by the dental schools or commissioned by the external institutions, for their dental students. Most dental students typically complete this training course before graduation from the dental schools, ensuring they are immediately qualified to operate the dental X-ray equipment upon entering the dental practice. This training course typically takes two days to complete. It consists of the lectures only, covering basic radiation, radiation protection, radiation applications, and radiation protection regulations. Like the previous RPTD program, the participants must pass an examination to receive a certificate of completion. However, the current RPTD program is designed based on general radiation physics and does not include the specific radiation protection training for dentistry, nor does it include the hands-on training.

Currently, the dentists receive the lifelong legal certification to operate the dental X-ray machines when completing the RPTD. The current RPTD program does not include radiation protection specifically designed for

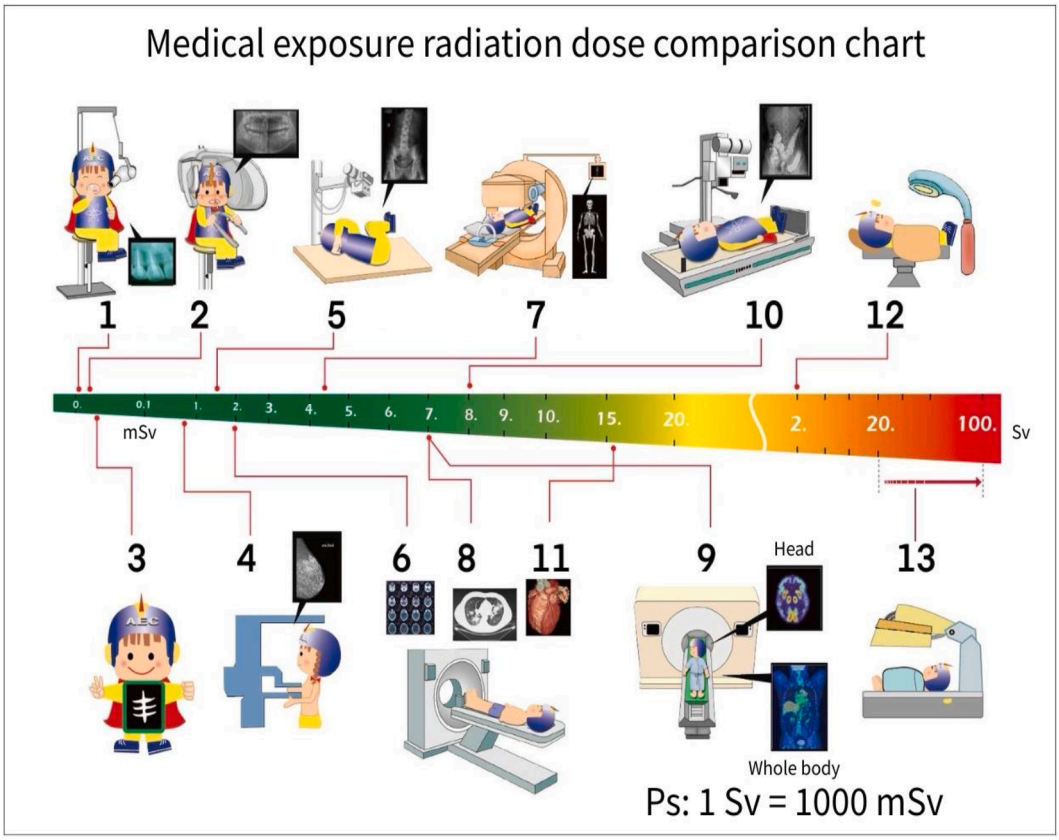

Figure 1 A medical exposure radiation dose comparison chart (Chinese Version) published by the Atomic Energy Council (AEC) in 2010 shows that taking a periapical radiograph needs the lowest radiation dose among all types of medical imaging. In this study, we translated this chart from Chinese into English. The radiation doses of various medical exposures are arranged in an order from low to high radiation doses and are shown as follows: (1) periapical radiography (0.005 mSv), (2) panoramic radiography (0.01 mSv), (3) chest radiography (0.02 mSv), (4) mammography (0.7 mSv), (5) lumbar spine radiography (1.5 mSv), (6) cranial computed tomography (CT) scan (2 mSv), (7) bone scan (technetium-99 m) (4.4 mSv), (8) chest CT scan (7 mSv), (9) positron emission tomography (PET) (7 mSv) (10) gastrointestinal barium radiography (8 mSv) (11) coronary artery CT scan (16 mSv) (12) cobalt-60 teletherapy (2 Sv), and (13) total dose of cancer radiation therapy (20—100 Sv).

dentistry and does not provide a practical course, making it difficult to strengthen the professional knowledge of dental radiation protection among the dental students and dentists. Even though the dental radiography carries the lowest radiation exposure risk among all types of medical imaging, dental radiation protection cannot be ignored.[2] In the future, the goal of developing professional knowledge in dental radiation protection among the dental students and dentists can be achieved within the dental education system. This can be achieved by teaching the dental students radiation protection through the undergraduate dental radiology courses and providing the dentists with new expertise through the continuing education.[3] Furthermore, the promotion of new healthcare initiatives can contribute to this goal. The medical image sharing functionality of the National Health Insurance (NHI) MediCloud System is a prime example.[4]

This study aimed to explore the evolution of radiation protection training for the dental students and dentists in Taiwan and to elucidate the current and future prospects for developing radiation protection knowledge in dentistry. Indeed, radiation protection is crucial in dental care and is closely linked to the digital transformation of dentistry. The increasing popularity of cone-beam computed tomography (CBCT) in dentistry has further highlighted the importance of dental radiation protection.

Declaration of competing interest

The authors have no conflicts of interest relevant to this article.

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