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Perspective article

# Survey of the operating models of dental radiology in general hospitals in Taiwan

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In late 1895, Wilhelm Conrad Roentgen discovered X-rays. In 1896, two weeks after Roentgen's discovery published,

the German dentist Otto Walkhoff acquired an X-ray radiograph of his own teeth with the help of Fritz Giesel.<sup>1,2</sup> This story presents the fact that the world's first X-ray radiograph of human teeth was born, while the world's first person assisting a dentist in performing dental radiology work also appeared simultaneously. In addition, the first X-ray machine for dental and jawbone disease diagnosis was manufactured by the current German company Siemens in 1905. Thus, the field of dental radiology has existed for more than 120 years.<sup>1</sup>

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In fact, the development of dental radiology in Taiwan started as early as the Japanese colonial period (1895–1945), and its development is almost synchronized with the world.<sup>3,4</sup> Today, among various clinical specialties, dentistry is the one that is mostly dependent on the usage of radiology for diagnosis of dental and jawbone diseases. During dental procedures, various types of dental radiography are needed for dental and jawbone disease evaluation and diagnosis. These include periapical, bite-wing, occlusal, panoramic, cephalometric, and temporomandibular joint (TMJ) radiographies, and cone-beam computed tomography (CBCT). In a general hospital, there should be a dedicated imaging medicine (or radiology) department that sets up various imaging equipment to accept requests from various clinical departments and to perform different specific radiographies for the patients. However, only the dental department usually has its own dental X-ray equipment, and there are certified medical radiation technologists (MRTs), also known as dental radiation technologists (DRTs), who take dental radiography for dental patients within the dental department. In this article, we explored an overview of the operating models of dental radiology in general hospitals in Taiwan through a survey online.

There is no national list of general hospitals with the DRTs who are responsible for the dental radiology work in the dental departments. However, the dental radiology division of National Taiwan University Hospital (NTUH) informally organized a group for the DRTs in Taiwan.<sup>5</sup> During October 2023, we sent a questionnaire to the DRTs of the 58 general hospitals using an online form for the survey of the operating models of dental radiology in general hospitals in Taiwan by census through the interpersonal network of the dental radiology division of NTUH.

We divided the dental radiology division into three operating models based on the independence of its operation. The type A operating model was that the dental department of the hospital had an independent dental radiology division with its own dedicated DRTs. The dental radiology work was completely performed by these DRTs. The DRTs could arrange their vacations by themselves. The type B operating model was that the dental department of the hospital had an independent dental radiology division with its own dedicated DRTs. However, when the DRTs were on vacation, the Department of Imaging Medicine (or Radiology) sent the MRTs to support the dental radiology work. The type C operating model was that the dental department of the hospital had an independent dental radiology division, but it did not have its own dedicated DRTs. The dental radiology work was completely supported by the MRTs sent by the Department of Imaging Medicine (or Radiology). Among them, the type A is the most independent and requires no external support of the manpower. The type B has moderate independence and requires external support of the manpower, when the manpower is insufficient. The type C is the least independent and completely dependent on the external support of the manpower. In this survey, the respondents self-evaluated their dental radiology operating models to confirm which of the above-mentioned operating models they met. If their dental radiology operating models did not fall within or was

not exactly the model described above. It was up to them to explain their operating models. Furthermore, everyone was invited to add additional explanations if they wished. Currently, 60 hospitals had the DRTs who were responsible for the dental radiology work in the dental departments. Among them, a dental hospital and a small branch of a hospital were excluded in this study. Finally, there were 58 completed questionnaires returned to us for further analysis with a valid response rate of 100 %. The survey results are shown in Table 1.

Among the 58 general hospitals with the DRTs working in the dental departments, 7 indicated that their dental radiology operating models did not fall within the above-mentioned three types or was not exactly the operating model described above. They all expressed that their hospitals did not have an independent dental radiology division. The dental radiology work was performed by the dedicated DRTs of the dental departments or by the assigned DRTs from other departments, such as Departments of Imaging Medicine (or Radiology) or Nursing. Under this operating model, some DRTs were assigned to the works other than the dental radiology. This means that under this type of the operating model, the independence of dental radiology was lower than that of the type C. Therefore, we defined it as the type D. Of the 58 general hospitals, the largest number were the medical centers (24, 41.4 %), followed by the metropolitan hospitals (23, 39.7 %) and the local community hospitals (11, 19.0 %). Among different operating models of dental radiology, the largest number were the type A (37, 63.8 %), followed by the type C (8, 13.8 %), the type D (7, 12.1 %), and the type B (6, 10.3 %). There was a special situation: If there was a shortage of the manpower because the DRTs were on vacation, the dental radiology work was performed by the qualified dentists themselves. In proportion, the type D most often had this situation (85.7 %, 6/7), followed by the type A (64.9 %, 24/37) and the type B (33.3 %, 2/6), while the type C did not have this situation. Furthermore, there was a special situation: Some of the dental X-ray imaging equipment were placed in the Department of Imaging Medicine (or Radiology). If there was a need for the related dental X-ray imaging, the patients should go to the Department of Imaging Medicine (or Radiology) to take radiography. Among the hospitals using the type A operating model, 5 of them had this situation.

According to our previous research, up to 68.8 % (130/189) of the hospitals with a dental department did not have the DRTs who were responsible for the dental radiology work in Taiwan in 2022.<sup>5</sup> An independent dental radiology division with a high degree of independence and the sufficient DRT manpower is crucial to the quality of medical services in the hospital dentistry. Many DRTs in this study indicate that there is a shortage of the DRT manpower in the dental department and they hope that medical policies will pay attention to the recruitment of the DRT manpower and the improvement of the independence of the dental radiology division. We consider that an independent dental radiology is a new practice direction for the MRTs. It is time to expand their potential participation in the field of dental radiology.<sup>5–7</sup>

**Table 1** The number of general hospitals using different operating models of dental radiology in Taiwan.

| <sup>a</sup> Operating model of dental radiology | <sup>b</sup> Medical center | Metropolitan hospital | Local community hospital | Total | <sup>c</sup> Special situation |            |
|--------------------------------------------------|-----------------------------|-----------------------|--------------------------|-------|--------------------------------|------------|
|                                                  |                             |                       |                          |       | A (%)                          | B (%)      |
| Type A                                           | 20 (1)                      | 13                    | 4                        | 37    | 24 (64.9 %)                    | 5 (13.5 %) |
| Type B                                           | 3 (2)                       | 2                     | 1                        | 6     | 2 (33.3 %)                     | 0          |
| Type C                                           | 1                           | 3                     | 4                        | 8     | 0                              | 0          |
| Type D                                           | 0                           | 5                     | 2                        | 7     | 6 (85.7 %)                     | 0          |
| Overall                                          | 24 (3)                      | 23                    | 11                       | 58    | 32 (55.2 %)                    | 5 (8.6 %)  |

<sup>a</sup> The operating models of dental radiology in Taiwan:

Type A: The dental department of the hospital had an independent dental radiology division with its own dedicated DRTs. The dental radiology work was completely performed by these DRTs. The DRTs could arrange their vacations by themselves.

Type B: The dental department of the hospital had an independent dental radiology division with its own dedicated DRTs. However, when the DRTs were on vacation, the Department of Imaging Medicine (or Radiology) sent the MRTs to support the dental radiology work.

Type C: The dental department of the hospital had an independent dental radiology division, but it did not have its own dedicated DRTs. The dental radiology work was completely supported by the MRTs sent by the Department of Imaging Medicine (or Radiology).

Type D: The dental department of the hospital did not have an independent dental radiology division. The dental radiology work was performed by the dedicated DRTs of the dental departments or by the assigned DRTs from other departments, such as Departments of Imaging Medicine (or Radiology) or Nursing.

<sup>b</sup> The number of medical centers includes the would-be medical centers. The number in the brackets is the number of the would-be medical centers.

<sup>c</sup> Special situation:

A: If there was a shortage of the manpower because the DRTs were on vacation, the dental radiology work was performed by the qualified dentists themselves.

B: Some of the dental X-ray imaging equipment were placed in the Department of Imaging Medicine (or Radiology). If there was a need for the related dental X-ray imaging, the patients should go to the Department of Imaging Medicine (or Radiology) to take radiography.

## Declaration of competing interest

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

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