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Radiological technologists' self-assessment of professional competence in Japan. A survey study

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Abstract

The competence of radiographers is a prerequisite for guaranteeing high patient safety and quality of care. The purpose of the study was to describe the clinically active Radiological Technologists' professional competence in diagnostic radiological activities in Japan. Method was a questionnaire study with the measuring instrument Radiographers' Competence Scale which consists of two domains: "Nurse-initiated care" and "Technical and radiographic processes". Each competence was estimated based on the level and frequency of use. The study was conducted at three different hospitals with a total of 76 respondents. Analysis was done through the statistics program SPSS. The competence with the highest rated level was 'Responsibility for preparing the medico-technical equipment', the lowest rated was 'Guiding the patient's relatives'. The highest rated frequency was 'Producing accurate and correct images', the lowest was 'Guiding the patient's relatives'. In summary, the study opens up new doors for the exchange of competence at both international and national level.

Introduction

Competence is an important and controversial concept in healthcare professions, which lacks a generally accepted definition [1]. General competence was defined by the nursing researcher Benner [2] as the ability to carry out a task with a desired outcome. Radiographers are responsible for the patient's physical, psychological and social well-being during diagnostic radiologic examinations and interventions [3]. The radiographer's competence is to ensure a high-quality balance between caring for the patient with person-centered care while executing the examinations and interventions to produce adequate material [4-5]. A diagnostic radiology department is characterized by advanced radiological technology and equipment, which requires a high level of competence and specialist knowledge in both nursing and technology [6]. With the technical developments in healthcare there is an increased workload in diagnostic radiology departments and ensuring a high level of competence is of high value [7].

In Sweden, recommended competences for licensed radiographers are described in a competency description by The Swedish Society of Radiographers (SSR) [8]. Andersson [4] describes professional competence based on a self-assessment instrument: Radiographers' competence scale (RCS). There is a lack of documentation and scientific studies that describe the professional competence of the corresponding profession internationally and specifically the Japanese equivalent of the radiographer, the radiological technologist (RT). This study can contribute to increased knowledge about the competences of RTs in Japan and thus contribute to increased understanding and promotion of cooperation between professionals.

The Radiographer's profession in Sweden

Radiography is the radiographer's scientific field, which is interdisciplinary and combines aspects from nursing, medicine, methodology and medical technology [8-9]. The radiographer conducts d examinations and treatments in a manner ensuring the best possible diagnostic data, with the lowest possible radiation dose to the patient and through person-centered care [8,10-11]. The radiographer works on the basis of the peri-radiographic process [9] which consists of the pre-, intra- and post-radiographic phase [7]. Andersson et al. [11] describes nursing based on different areas of competence: through direct patient contact or indirect patient contact. The first is characterized by guidance of the patient, the adaptation of the examination to the patient and to meet the patient's need of support. The second is characterized by improving the organization of the department, improving the quality of the medical image and collaborating with other healthcare professions [11].

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Professional titles around the globe

The profession does not have a globally uniform professional title. There is a great variety in areas of responsibility, competence and how the profession is regulated [12]. The European Federation of Radiographer Societies (EFRS) has compiled a summary of professional titles used for radiographers in Europe [3]. Similar information on professional titles and the profession in countries outside of Europe is incomplete. The corresponding professional title in the United States is radiologic technologist [13]. The professional title differs between different countries in Asia, Africa and the Middle East; radiographer is used in Singapore, Malaysia, Saudi Arabia, South Africa and Nigeria, among others, while radiologic technologist is used in Vietnam, Taiwan and Thailand [14].

Diagnostic radiological activities in Japan

Japanese society has long consisted of a homogeneous population but has recently become increasingly internationalized as the number of residents with a foreign background has increased [16-17]. However, immigration does not compensate for the very slow population growth Japan has had in recent decades [16]. A major challenge facing Japanese society is that the population of older people (> 65 years) is increasing and exceeding the number of births [16]. In 2019, 28% of the population was older than 64 years and 12% were younger than 15 years [16]. As a result of the growing elderly population, the need for healthcare is expected to increase with increasing costs the older the inhabitants become [18]. This is a global phenomenon that affects virtually all countries in the world [19] and the commission report *Japan as the front-runner of super-aged societies: Perspectives from medicine and medical care in Japan* highlights the necessity of international cooperation to develop the healthcare of the future [18].

Japan has a long history of using X-rays in clinical use. The first X-ray image in Japan was taken in 1896, and in 1925 there were approximately 1500 radiographers nationally [20].

In 1927, the first institute was established with the aim of teaching X-ray techniques based on evidence-based learning. In 1947, the profession gathered under the association now known as the Japanese Association of Radiological Technologists (JART). The association was founded under the name Establishment of the Japan Association of Radiographers and in 1969 changed its name to JART. The organization operates under the Ministry of Health, Labor and Welfare (MHLW) [20]. In 1975, the first computed tomography (CT) was introduced in Japan [21,22]. Its purpose was to take cranial images and they started with a full body scan shortly afterwards [22]. Prior to that, conventional X-rays and palpation or angiography had been used to diagnose certain diseases and to locate and assess the degree of, for example, sarcoma [23]. In 1978, JART became an official member of the International Society of Radiographers and Radiological Technologists (ISRRT). Since then, the profession has undergone development, among other things by expanding areas of responsibility for what an RT is allowed to do. In 1983, the Radiology Technicians Act was passed, which gave RTs responsibilities in conventional X-ray, CT, Magnetic Resonance Imaging (MRI), radiotherapy and angiography. RTs' areas of responsibility are constantly evolving. The Radiology Technicians Act was revised in 1993 to also include, among other things, ultrasound and in 2010 including an image review and consultant in connection with X-ray examinations. Further revision was made in 2015 and RTs can now also administer intravenous contrast injection through automated contrast injectors, perform removal of needles and hemostasis, examination of the lower digestive tract (rectal catheter placement and administration of contrast) and administration of oxygen during radiotherapy [20,21,24].

Radiological technologist profession in Japan

The professional title was 'medical radiographer' until 1968 when the first national examination for RTs took place [20]. JART describes the general principles of the profession which RTs in Japan should adhere to in their clinical work: RTs must perform the services that healthcare requires, they have obligations towards their profession and must continue to study for the benefit of humanity and respect and practice informed consent [25].

The education to become an RT has undergone major changes over the years, which have taken place in connection with the development of diagnostic imaging in healthcare [26]. Education is available at universities and colleges (technical colleges) where the length is generally 4 years and 3 years, respectively. The 3-year education was designed based on a time when RTs only did simpler conventional examinations, angiography and superficial treatments. RTs today have a much wider range of possible tasks with increasingly advanced technology. In the Journal of JART English edition 2017, the current president Yasuo Nakazawa [26] writes that the organization should fight for a 4-year education to be a minimum in order to obtain certification. He believes that a possible 6-year education should be standard in the future. With a minimum requirement for a 4-year education, Nakazawa believes that the number of highly educated RTs in the workforce would increase. With this, RTs would gain a greater influence on MHLW and higher autonomy to influence their own profession in matters such as regulation and design of the national examination to obtain certification. At present, it is mainly radiologists and physicists who have this responsibility from the current ministry [26].

Japanese undergraduate education at university level is mainly focused on courses in physical sciences [27]. Prospective RTs gain a deep understanding and knowledge of relevant physical concepts in diagnostic radiology, with regard to, among other things, image quality, radiation doses and the strengths and weaknesses of the digital detector [27]. Less focus is on courses such as patient care, communication, psychology and interprofessional learning. Often these courses are elective rather than a compulsory part of the program. Work-based education takes place late in the education, during the third or fourth year, and is generally not given as much focus as in corresponding university educations in Europe [27]. During the last year, many universities focus on preparing their students for the national examination that provides a credential, through theory and practical exercises. To work as an RT in Japan, you must obtain a certification, which is obtained after passing a national examination [27]. According to Y. Kono (personal communication, 26/11 2019), previous education before certification does not need to have a major impact on future work tasks or salary in working life. In order to be able to meet today's and the future's need for diagnostic imaging, professionals need to continuously develop their competence in technology and evidence-based research [28].

Purpose

The purpose of the study was to describe the professional competence of the Japanese radiological technologists (RTs) based on the self-assessment instrument Radiographers' Competence Scale (RCS).

Methods

The design of the study was descriptive and quantitative and was carried out using a questionnaire as a measuring instrument. A measuring instrument must be validity and reliability tested for use in scientific studies [29,30] and this study used Radiographers' Competence Scale (RCS) [31].

A total of 76 RTs was included in the study. Inclusion criteria were clinically active RTs in diagnostic radiology. Exclusion criteria were unlicensed RTs and those employed for administrative services. The study was conducted in three different diagnostic radiology departments in Japan. The sample of diagnostic radiology departments were three hospitals of varying sizes: a hospital with an international character (Hospital a), a university hospital in a small town (Hospital b) and a large hospital in a large city (Hospital c). Via the Google search service, a selection of suitable hospitals was made, where administrative staff for each hospital were contacted via e-mail and/or telephone. Through administrative staff, contact was passed on to various contact persons or intermediaries within the hospitals' respective diagnostic radiological departments. The questionnaires were distributed either as a paper questionnaire (Hospitals a and b) or as an online questionnaire (Hospital c) to all RTs that met the inclusion criteria. The distribution of the questionnaires depended on which technical arrangements were most suitable.

The measuring instrument Radiographers' Competence Scale (RCS) was used for the study [31]. RCS is in English, consists of 28 questions and is divided into two domains: A. 'Nurse initiated care' and B. "Technical and radiographic processes". A consists of 18 questions and B of 10 questions. At the end of each part of the instrument, there is room for comments in the form of free text. Each question represents a competence and is answered through a two-part scale where one part focuses on the level of competence and the other on the frequency. The level of competence is answered through a 10-point scale with 10 as the highest value and 1 as the lowest. The frequency is answered on a 6-point scale with the options: "always used", "very often used", "often used", "sometimes used", "rarely used" and "never used". In order to reach as many RTs as possible and so that the English language would not be an obstacle to participation, RCS was translated into Japanese. The translation was made by a Japanese contact person who worked at a university specializing in medicine and healthcare. The person had Japanese as a mother tongue and good knowledge of the English language. To clarify parts of the content of the survey, this was sent between the authors and the Japanese contact person until agreement was reached. Subsequently, the translation was reviewed and corrected for medical terms by one of the three hospitals' heads of operations, a radiologist. The authors together with the creator of RCS discussed the translation and also reached a consensus on the issues in the survey that was subsequently used for this study.

Data collection was carried out through November-December 2019. An application for permission to carry out the study was sent to all diagnostic radiology department managers who gave consent for the study to be carried out. The authors then contacted people at each hospital who acted as intermediaries, who were informed about the study and in what way they were expected to assist the authors. For example, by determining the number of questionnaires that would be distributed to the various departments.

Surveys were distributed as regular e-mail or online. All participants were invited with information about the study in a letter that also contained contact information for the authors and the supervisor. The letter was attached to the questionnaire as a separate file in the e-mail invitation or inside the A4 envelope.

At Hospital a) a total of 50 questionnaires were distributed by regular mail. Information was given that completed questionnaires should be submitted in a sealed box located in close proximity to the intermediary's expedition in the diagnostic radiology department. The authors visited the hospital at the end of November 2019 (27/11 2019) to obtain the completed questionnaires. A total of 22 questionnaire responses were received and the dropout rate was thus 56%.

At Hospital b) a total of 30 questionnaires were distributed as an attachment in an e-mail that was printed on the spot. Completed questionnaires were submitted in a sealed box placed in close proximity to the intermediary's expedition in the diagnostic radiology department. The sealed box was then sent to the hospital's university campus and was sealed until the beginning of December (05/12 2019) when the authors themselves picked it up. A total of 28 completed questionnaires were received and the dropout rate was thus 6.7%.

At Hospital c) 40 surveys were distributed via Google Form by intermediary where the answers went to one of the authors. A total of 26 completed questionnaires were received and the dropout rate was thus 35%. The data collection was carried out over a 5-week period during November and December 2019. The authors gave instructions to intermediaries or contact persons to send out a reminder to the participants about the implementation of the survey. The first reminder was sent out two weeks after the first mailing and the second reminder after another week. The third reminder was sent four weeks after the first mailing. A total of four mailings were made, of which three were reminders. A total of 76 completed questionnaires were received from the three hospitals and the response rate was 63.3%.

The study uses descriptive statistics and for processing, the statistical computer program Statistical Package for the Social Sciences (SPSS) version 26 was used. As RCS provides data with an ordinal scale it is recommended that the median is used for analysis. The median is the middle value obtained when sorting the collected values from lowest to highest. The advantage of the median is that it is not affected by extreme values and is therefore preferable as point estimation when collected data has an asymmetric distribution of values [30]. In the study by Andersson et al. [31] the mean (M) of the reported data and standard deviation (SD) was presented in addition to the median. Each paper survey submitted was marked with a code number and the web-based surveys were automatically numbered in Google Forms. Responses from surveys were transferred from paper surveys and online surveys to SPSS manually. Through SPSS, data material was obtained that was used to create own tables that report self-assessment of competence level and frequency of use.

Results

A total of 76 RTs participated and completed the survey. The results are presented in two tables, one based on level of competence (Table 1) and one based on frequency of use (Table 2). Most competences were highly valued both in terms of level and frequency of use. The results are presented under the domains A. Nurse initiated care and B. Technical and Radiographic processes.

Self-assessed level of professional competence

Table 1. illustrates that in domain A, the highest valued competence was Observing and monitoring the patient (M = 7.14). The lowest rated competence was 'Guiding the patient's relatives' (M = 4.62). The highest and lowest rated competencies in domain B were 'Responsibility for preparing the medico-technical equipment' (M = 7.61) and 'Preliminary assessment of images' (M = 6.50).

Table 1. Radiological Technologists self-assessed level of competence.

A. Competence related to "Nurse-initiated care"	Total	Missing	Median (min-max; mean, SD)
Carrying out doctor's prescriptions	66	10	6.00 (1-10; 6.12, 2.52)
Applying ethical guidelines	66	10	6.00 (1-10; 5.71, 2.46)
Adequately informing the patient	66	10	7.00 (1-10; 6.73, 2.71)
Guiding and educating the patient	65	11	7.00 (1-10; 5.95, 2.42)
Empowering the patient by involving him/her in the examination and treatment	66	10	6.00 (1-10; 5.74, 2.33)
Guiding the patient's relatives	65	11	5.00 (1-10; 4.62, 2.75)
Encouraging and supporting the patient	65	11	7.00 (1-10; 5.88, 2.63)
Protecting the patient's integrity	66	10	7.00 (1-10; 6.77, 2.25)
Alleviating the patient's anxiety	65	11	7.00 (1-10; 6.88, 2.11)
Judging the risk of leaving the patient unattended	66	10	7.00 (1-10; 6.64, 2.52)
Observing and monitoring the patient	64	12	7.50 (1-10; 7.14, 2.00)
Identifying and encountering the patient in a state of shock	66	10	5.00 (1-10; 5.32, 2.32)
Identifying pain and pain reactions	66	10	6.00 (1-10; 5.85, 2.43)
Collaborating with internal and external colleagues	65	11	7.00 (1-10;6.80, 2.30)
Collaborating with other internal and external professionals	66	10	6.00 (1-10; 5.86, 2.17)
Supervising and training colleagues and other co-workers	66	10	6.00 (1-10; 6.03, 2.20)
Reporting to colleagues and other professionals, internal as well as external	66	10	7.00 (1-10; 6.11, 2.14)
Participating in quality improvement regarding patient safety and care	65	11	7.00 (1-10; 6.32, 1.99)
B. Competence related to "Technical and Radiographic processes"	**Total**	**Missing**	**Median (min-max; mean, SD)**
Organizing and planning taking account of the clinical situation	70	6	7.00 (2-10; 6.86, 1.86)
Responsibility for preparing the medico-technical equipment	70	6	8.00 (3-10; 7.61, 1.75)
Independently planning and preparing work on the basis of existing documentation	69	7	7.00 (1-10; 6.74, 2.03)
Prioritizing patients in the workflow	68	8	8.00 (2-10; 7.32, 1.79)
Adapting the examination to the patient's prerequisites and needs	69	7	7.00 (2-10; 7.07, 2.13)
Minimizing radiation doses for patient and staff	69	7	8.00 (2-10; 7.16, 2.01)
Producing accurate and correct images	69	7	8.00 (2-10; 7.52, 1.84)
Evaluating the quality of the medical images in relation to the referral and the question stated therein	70	6	7.00 (2-10; 6.96, 1.99)
Optimizing the quality of the image	70	6	7.00 (2-10; 6.79, 1.79)
Preliminary assessment of images	70	6	7.00 (2-10; 6.50, 1.88)

Self-assessed frequency of use of professional competence

Table 2. illustrates the self-estimated frequency of use of professional competence. In domain A, the most frequently used competence was 'Observing and monitoring the patient' (M=4.29) and 'Collaborating with internal and external colleagues' (M=4.29). The competence with the lowest median in domain A was 'Guiding the patient's relatives' (M=2.51). In domain B, the competency 'Producing accurate and correct images' (M=4.97) was rated as the most frequently used while 'Preliminary assessment of images' (M=3.89) was rated as the least frequently used competency.

Table 2. Radiological Technologists self-assessed use of competence

A. Competence relating to use of "Nurse-initiated care"	Total	Frequency (%)	Mean (SD)	Median (min-max)
Carrying out doctor's prescriptions:				
Never	0	0		
Very seldom	13	17.1		
Sometimes	13	17.1	4.19 (1.53)	4.00 (2-6)
Often	9	11.8		
Very often	12	15.8		
Always	20	26.3		
Applying ethical guidelines:				
Never	2	19.7		
Very seldom	15	21.1		
Sometimes	15	19.7	3.73 (1.40)	4.00 (1-6)
Often	16	21.1		
Very often	14	18.4		
Always	9	11.8		
Adequately informing the patient:				
Never	3	3.9		
Very seldom	9	11.8		
Sometimes	11	14.5	4.18 (1.51)	5.00 (1-6)
Often	10	13.2		
Very often	10	26.3		
Always	15	19.7		
Guiding and educating the patient:				
Never	4	5.3		
Very seldom	17	22.4		
Sometimes	17	22.4	3.41 (1.36)	3.00 (1-6)
Often	14	18.4		
Very often	14	18.4		
Always	4	5.3		
Empowering the patient by involving in the examination and treatment:				
Never	4	5.3		
Very seldom	10	13.2		
Sometimes	20	26.3	3.51 (1.23)	4.00 (1-6)
Often	25	32.9		
Very often	7	9.2		
Always	5	6.6		
Guiding the patient's relatives:				
Never	21	27.6		
Very seldom	19	25		
Sometimes	15	19.7	2.51 (1.37)	2.00 (1-6)
Often	10	13.2		
Very often	5.6	6.6		
Always	2.2	2.6		
Encouraging and supporting the patient:				
Never	7	9.2		
Very seldom	12	15.8		
Sometimes	18	23.7	3.36 (1.35)	3.00 (1-6)
Often	19	25		
Very often	10	13.2		
Always	4	5.3		
Protecting the patient's integrity:			3.94 (1.28)	4.00 (1-6)
Never	1	1.3		
Very seldom	8	10.5		
Sometimes	18	23.7		
Often	21	27.6		
Very often	11	14.5		
Always	11	14.5		

Alleviating the patient's anxiety: Never Very seldom Sometimes Often Very often Always	 1 6 16 23 14 12	 1.3 7.9 21.1 30.3 18.4 15.8	4.10 (1.25)	4.00 (1-6)
Judging the risk of leaving the patient unattended: Never Very seldom Sometimes Often Very often Always	 3 15 11 14 16 12	 3.9 19.7 14.5 18.4 21.1 15.8	3.86 (1.52)	4.00 (1-6)
Observing and monitoring the patient: Never Very seldom Sometimes Often Very often Always	 1 6 14 14 19 15	 1.3 7.9 18.4 18.4 25 19.7	4.29 (1.33)	4.00 (1-6)
Identifying and encountering the patient in a state of shock: Never Very seldom Sometimes Often Very often Always	 7 27 14 16 6.6 0	 9.2 35.5 18.4 21.1 6.6 0	2.78 (1.14)	3.00 (1-5)
Identifying pain and pain reactions: Never Very seldom Sometimes Often Very often Always	 3 20 16 18 9 6	 3.9 26.3 21.1 23.7 11.8 7.9	3.39 (1.35)	3.00 (1-6)
Collaborating with internal and external colleagues: Never Very seldom Sometimes Often Very often Always	 2 5 12 19 19 15	 2.6 6.6 15.8 25 25 19.7	4.29 (1.32)	4.00 (1-6)
Collaborating with other internal and external professionals: Never Very seldom Sometimes Often Very often Always	 2 10 27 11 16 4	 2.6 13.2 35.5 14.5 21.1 5.3	3.59 (1.23)	3.00 (1-6)
Supervising and training colleagues and other co-workers: Never Very seldom Sometimes Often Very often Always	 3 6 24 14 20 5	 3.9 7.9 31.6 18.4 26.3 6.6	3.79 (1.26)	4.00 (1-6)

Reporting to colleagues and other professionals, internal as well as external: Never Very seldom Sometimes Often Very often Always	 2 12 29 11 15 3	 2.6 15.8 38.2 14.5 19.7 3.9	3.47 (1.120)	3.00 (1-6)
Participating in quality improvement regarding patient safety and care: Never Very seldom Sometimes Often Very often Always	 1 13 17 19 15 7	 1.3 17.1 22.4 25 19.7 9.2	3.76 (1.28)	4.00 (1-6)
B. Competence relating to use of "Technical and Radiographic processes"	**Total**	**Frequency (%)**	**Mean (SD)**	**Median (min-max)**
Organizing and planning taking account of the clinical situation: Never Very seldom Sometimes Often Very often Always	 0 4 14 24 22 10	 0 5.3 18.4 31.6 28.9 13.2	4.27 (1.09)	4.00 (2-6)
Responsibility for preparing the medico-technical equipment: Never Very seldom Sometimes Often Very often Always	 0 3 11 17 18 24	 0 3.9 14.5 22.5 23.7 31.6	4.67 (1.20)	5.00 (2-6)
Independently planning and preparing work on the basis of existing documentation: Never Very seldom Sometimes Often Very often Always	 1 9 14 23 19 9	 1.3 11.8 18.4 30.3 25 11.8	4.03 (1.24)	4.00 (1-6)
Prioritizing patients in the workflow: Never Very seldom Sometimes Often Very often Always	 1 3 12 18 26 13	 1.3 3.9 15.8 23.7 34.2 17.1	4.42 (1.17)	5.00 (1-6)
Adapting the examination to the patient's prerequisites and needs: Never Very seldom Sometimes Often Very often Always	 0 7 14 19 18 16	 0 9.2 18.4 25 23.7 21.1	4.30 (1.27)	4.00 (2-6)

Minimizing radiation doses for patient and staff: Never Very seldom Sometimes Often Very often Always	 0 4 11 17 22 20	 0 5.3 14.4 22.4 28.9 26.3	4.58 (1.19)	5.00 (2-6)
Producing accurate and correct images: Never Very seldom Sometimes Often Very often Always	 0 3 6 12 22 31	 0 3.9 7.9 15.8 28.9 40.8	4.97 (1.13)	5.00 (2-6)
Evaluating the quality of the medical images in relation to the referral and the question stated therein: Never Very seldom Sometimes Often Very often Always	 0 6 12 22 21 14	 0 7.9 15.8 28.9 27.6 18.4	4.33 (1.19)	4.00 (2-6)
Optimizing the quality of the image: Never Very seldom Sometimes Often Very often Always	 0 3 16 27 14 14	 0 3.9 21.1 35.5 18.4 18.4	4.27 (1.13)	4.00 (2-6)
Preliminary assessment of images: Never Very seldom Sometimes Often Very often Always	 0 8 22 23 14 8	 0 10.5 28.9 30.3 18.4 10.5	3.89 (1.16)	4.00 (2-6)

Table 3. Radiological Technologists self-assessed level of competence

Total value for level of self-assessed professional competence	
Median (min-max; mean, SD)	7.00 (1-10; 181, 61.33)
A. Competences relating to "Nurse-initiated care"	
Mean	110.47/18= 6.13
B. Competences relating to "Technical and Radiographic process"	
Mean	70.53/10= 7.05

Table 4. Radiological Technologists self-assessed frequency of use of competence

Total value for self-assessed frequency of use of professional competence	
Median (min-max; mean, SD)	4.00 (1-6;109.88, 34.39)
A. Competences relating to"Nurse-initiated care"	
Mean	66.15/18= 3.67
B. Competences relating to"Technical and Radiographic process"	
Mean	45.73/10= 4.37

Table 3 describes total values for the level of self-assessed competence in median, min-max, mean value and SD, as well as mean value for domains A and B.

Table 4 describes total values for self-assessed frequency of use of competence in median, min-max, mean value and SD, as well as mean value for domains A and B.

Discussion

The study had a quantitative descriptive design [30] that used questionnaires for data collection, which enabled RCS to be distributed to a large number of participants in a short time [29]. The goal of a quantitative study is to achieve generalizability, i.e., the result is applicable to individuals even outside the part of the sample that participated in the study [30]. To achieve this, studies may have a variety of participants as it increases transferability and credibility in the sample [29]. The aim of the study selection was that the participants worked in clinical activities and used their skills in their daily work. Therefore, it was decided to exclude RTs with administrative services as these were not considered to work clinically. Inclusion and exclusion criteria were designed after discussion with supervisors and based on what was reasonable based on the purpose of the study. Examples of further exclusion criteria could be experience of clinical work, education or RTs working with specific modalities. The fear was to exclude suitable participants through too strict exclusion criteria. To be able to add more information about the sample, the study could have collected background variables of participants. If background variables had been added, further statistical comparative calculations could have been made based on estimates in relation to gender, age and number of active years in the profession [32].

The survey was translated from English to Japanese, which decreased the risk of a language barrier. However, to use a modified version of a validity and reliability tested instrument does risk the study losing credibility [30]. This could have been avoided by having the Japanese translation of RCS undergo a validation process to achieve the highest possible level of credibility. A pilot study would have been appropriate to conduct before the study, to increase validity and test the questions in the instrument [29]. Due to time constraints and limited resources this was not realistically feasible.

The study had a response rate of 63.3% which is traditionally lower than the range considered acceptable [29]. For the highest possible reliability, the higher the response rate is considered the better [30] but it is still considered by the authors to be an acceptable level of participation. The dropout rate was 36.7%. Loss could be due to cultural differences between Sweden and Japan; self-assessment of one's own knowledge and ability may have been a foreign concept to the participants and therefore be a reason for not participating in the study. If the authors had had a Japanese-speaking person at their disposal to write information letters to the participants, it could have increased the number of participants in the study. An additional reason for loss of participants may have been lack of time on the part of the clinically active RTs. One way to present the participant dropout in an illustrative manner would have been to include a dropout analysis in the form of a flow chart [29]. The authors did not have enough information about the loss of participants during the data collection to be able to make this kind of analysis.

Amongst the collected surveys some were received with domain A. left blank or with missing answers to questions. The authors chose to include surveys that lacked answers after discussion with statisticians and supervisors. Even though the inclusion could affect the result, the data that would otherwise have been lost was of too great a value for the study to exclude.

Only quantitative data from RCS were chosen to be analyzed and presented. The authors chose not to treat comments in this study. Inclusion could have required resources, such as one or several suitable people with adequate language skills, and insight and understanding of diagnostic radiology in Japan, in addition to being well acquainted with ethical guidelines and the purpose of the study. The authors themselves did not have the possibility to translate the written comments due to lack of proficiency in the Japanese language. The instrument RCS could not be modified by removing the area for free comments. Appropriate analysis of comments would have been qualitative text analysis [29]. Due to lack of insight, participants were not informed that written comments would not be reported in the results. If comments had been analyzed qualitatively, it might have provided additional aspects of the RTs professional competence.

Due to communication difficulties, the authors could not ensure that the procedure of given instructions was carried out correctly by intermediaries. As a result, the authors could not guarantee the distribution and collection process.

The authors considered one of the most significant findings to be that RTs rated their competences higher in domain B 'Technical and Radiographic Processes' compared to domain A 'Nurse Initiated Care'. This applied both in estimating the level of competence and in the frequency of use. The authors felt that this could be due to the fact that RTs in Japan to some extent do not relate to domain A. Since the professional title includes the term technologist, the focus is on the technical aspect of the profession. That some participants chose to exclude part A may also be a reflection on the fact that RTs in their education do not have much focus on nursing [27] and therefore do not see the care they provide as 'Nurse initiated care'.

Self-assessed level of professional competence

Table 1. reported that the estimate in domain B was high with a varying mean value of 6.50-7.61. The high ratings of competences related to technical and radiographic processes was a hypothesis the authors made during the creation of the project plan. The Japanese healthcare system is characterized by high-tech equipment [16] and this is in line with the authors' own experiences of having visited hospitals in the country.

The self-assessment of the competence 'Preliminary assessment of images' in domain B resulted in a low value, which can be compared with studies done in Sweden [31] and Lithuenia [33]. In these studies, RCS was used to examine radiographers' self-assessment of competence in Sweden [31], and to examine how radiologists and radiographers in Lithuania value the profession's competence respectively. In these studies, the lowest valued competence in domain B was also 'Preliminary assessment of images' [31,33]. This may indicate that the profession on an international scale values its ability of this competence as low. It could be an indication that the training for radiographers around the world is lacking in terms of developing the competence.

One of the most highly valued competences in domain A was 'Alleviating the patient's anxiety'. In similar competences related to guidance and providing adequate information to the patient, RTs rated themselves highly. Swedish radiographers also rated high in the competence 'Adequately informing the patient' [31]. This competence is included in the ethical guidelines which JART states that RTs must follow [25] and is also included in the competence description for Swedish radiographers [34].

A clear difference between this study and the study by Andersson et al. [31] is that radiographers in Sweden gave a low rating to the competence 'Participating in quality improvement regarding patient safety and care', compared to the RTs in the present study. One reason may be that in Japan, higher demands might be placed on RTs to participate in improvement work and development of the diagnostic radiology department. It may also be a sign that RTs are more involved in the technical part of the modalities than radiographers in Sweden.

Self-assessed frequency of use of professional competence

Table 4. illustrates a difference in the mean value between the two domains: domain B has a higher mean value (M = 4.37) than domain A (M = 3.68). This may indicate that RTs use their competences in the technical aspects of the profession more frequently than the competences related to nurse-initiated care in their clinical work. The difference in mean value could be affected by the higher answer rate in domain B.

The competences 'Producing accurate and correct images' (M = 4.97), 'Minimizing radiation doses for patient and staff' (M = 4.58) and 'Responsibility for preparing the medico-technical equipment' (M = 4.67) all have both a highly estimated average, and a high percentage estimate in variables 'Always' and 'Very often'. That 'Minimizing radiation doses to patients and staff' received a high estimate could be due to the fact that RTs have extensive knowledge of relevant physics and protective measures. This can increase the ability of RTs to implement evidence-based minimization measures in their operations.

A competence that received a low estimate in frequency of use was 'Empowering the patient by involving him/her in the examination and treatment' (M = 3.51). The frequency 'Never' was selected by 27.6% (n = 21) of RTs, which was the highest percentage in both domains. According to the authors' own observations, RTs may not have the highest responsibility for safeguarding the patient's emotional well-being during the examination. Instead, an accompanying nurse has this area of responsibility (personal communication, 26/11 2019). This division of patient responsibility can indicate that RTs do not see 'Empowering the patient by involving him/her in the examination and treatment' as their responsibility. The frequency of use of this competence was also rated low in the study by Vanckavičienė et al. [33]. This might indicate a low frequency of use of this competence in several different countries.

The competence 'Identifying and encountering the patient in a state of shock' received the rating M= 5.32 for self-assessed level of competence and M=2.78 for frequency of use, with 35.5% (n=27) choosing the frequency 'Very Seldom'. It is possible that RTs in the hospitals included in the study rarely need to exercise this competence. Lack of education at the undergraduate level or as a clinically active RT could also be reasons for this result. A low self-assessed level of professional competence could be seen in the study by Andersson et al. [31] where it received the lowest value of the competences.

In domain A, a competence with a high estimate was 'Adequately informing the patient' (M = 4.18) where RTs chose the frequency 'Always' with 19.7% (n = 15). This competence is an important part of both the Swedish radiographer profession and the Japanese RT profession [8,25]. In the study by Andersson et al. [31], it was the competence rated as most frequently used. Since the profession is characterized by short patient meetings and a high flow of patients [9] it is not surprising that RTs rate the frequency of use of this competence as high.

Conclusion and clinical implications

The results of the study highlight aspects of RTs' professional competence such as the high level and frequency of use of the technical part of the profession. The study also highlights competences which received low ratings in level and frequency of use, mainly relating to nurse-initiated care. The study contributes to an increased understanding of the Japanese RTs' areas of expertise. Clinical implications are that the study and RCS can be used in diagnostic radiology contexts and open new doors for the development of competence, both on a national and a global scale. Prior to the study, there was a knowledge gap regarding RT's professional competence. Reflection and evaluation of professional competence affects how education for the future radiographers should be designed [31] and documents the competences which are used or not used in the present moment. This provides a basis for planning and evaluating competence development in areas such as patient safety and organization.

The results can be used as a basis for future research and degree projects in internationalization. Further research is needed to provide a deeper understanding of RTs' professional competence and subjective experiences of the profession in Japan as well as globally.

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Conflicts of Interest

The Authors declare that there is no conflict of interest.

References

1. Lejonqvist GB, Eriksson K, Meretoja R. Evidence of clinical competence. Scand J Caring Sci. 2012;26(2):340-8.
2. Benner P. From novice to expert. Am J Nurs. 1982;82(3):402-407.
3. European Federation of Radiographer Societies. (2011). EFRS definition of a radiographer. Retrieved 2019-04-29 from https://api.efrs.eu/api/assets/publications/348
4. Andersson BT. Radiographers' professional competence: Development of a context-specific instrument. 2012; Dissertation, College Jönköping, Jönköping.
5. Murphy FJ. The paradox of imaging technology: A review of the literature. Radiography. 2006;12(2):169-174.
6. Björkman B, Fridell K, Tavakol Olofsson P. Plausible scenarios for the radiography profession in Sweden in 2025. Radiography (Lond). 2017;23(4):314-320.
7. Lundgren SM, Lundén M, Andersson BT. Radiography - How do students understand the concept of radiography? Radiography. 2015;21(2):68-73.
8. The Swedish Society of Radiographers, SSR. Description of competence (first edition). 2012. Stockholm: TMG
9. Lund University. VGRSS Radiology nurse program,

180 education credits. 2018. Retrieved 2019-04-29 from https://www.lu.se/lubas/i-uoh-lu-VGRSS

10. Ahonen S. Radiography – A conceptual approach. Radiography. 2008;14(4):288-293.
11. Andersson BT, Fridlund B, Elgán C, Axelsson AB. Radiographers' areas of professional competence related to good nursing care. Scand J Caring Sci. 2008;22(3):401-409.
12. Cowling C. A Global Overview of the changing roles of radiographers. Radiography. 2008;14(1):28-32.
13. The American Society of Radiologic Technologists. (n.d). About ASRT. Retrieved 2020-03-03 from https://www.asrt.org/main/about-asrt
14. International societies of Radiographers and Radiologic Technologists. National Societies. 2020. Retrieved 2020-03-25 from https://www.isrrt.org/national-societies?fbclid=IwAR2ygKSlNSTHdztvAAxj3yhnkBByU_aMM-d2FJxO8Ua31YjNQM19wSmmSuk
15. Statistics Bureau, Ministry of Internal Affairs and Communications. (n.d.). Current Population Estimates as of October 1, 2018. Retrieved 2019-04-27 from http://www.stat.go.jp/english/data/jinsui/2018np/index.html#a15k30-a
16. Nationalencyklopedin. (n.d). Japan. Retrieved 2020-02-24 from https://www-ne-se.ludwig.lub.lu.se/uppslagsverk/encyklopedi/lång/japan
17. National Institute of Population and Social Security Research. Registered Foreigners by Nationality: 1950-2015. 2017. Retrieved 2019-04-30 from http://www.ipss.go.jp/p-info/e/psj2017/PSJ2017.asp
18. Arai H, Ouchi Y, Toba K, et al. Japan as the front-runner of super-aged societies: Perspectives from medicine and medical care in Japan. Geriatr Gerontol Int. 2015;15(6):673-687.
19. United Nations, Department of Economic and Social Affairs, Population Division (2019). World Population Ageing 2019: Highlights. New York: United Nations
20. The Japan Association of Radiological Technologists [JART]. History of the Japan Association of Radiological Technologists (JART). Journal of JART English edition. 2018(1):4-5.
21. The Japan Association of Radiological Technologists [JART]. History of the Japan Association of Radiological Technologists (JART). 2019. Retrieved 2020-02-24 from http://www.jart.jp/en/profile/history.html
22. Matsumoto S. Changes in the diagnosis and treatment of soft tissue sarcoma in Japan, 1977-2016. J Orthop Sci. 2018;23(3):441-448.
23. Matsumoto S. Current and future aspects of the Japanese medical system in the treatment of musculoskeletal tumors. J Orthop Sci. 2013;18(4):505-508.
24. Nakazawa Y. Foreword: Regarding Publication of the English Edition. Journal of JART English edition. 2018; 2018(1):3.
25. The Japan Association of Radiological Technologists [JART]. General principles. 2019. Retrieved 2020-02-24 from http://www.jart.jp/en/profile/general_principles.html
26. Nakazawa Y. President's speech: Three Policies and Issues Facing the Japan Association of Radiological Technologists. Journal of JART English edition. 2017; 2017(1):25-32.
27. Akimoto T, Carauna CJ, Shimosegawa M. A qualitative comparative survey of First Cycle radiography programmes in Europe and Japan. Radiography. 2009;15(4):333-340.
28. The Japan Association of Radiological Technologists [JART]. Introduction. 2019. Retrieved 2020-02-27 from http://www.jart.jp/en/profile/about_jart_index.html
29. Henricson M. Scientific theory and method: From idea to examination within nursing (Edition 2:1). Lund: Student literature. 2017.
30. Polit DF, Beck CT. Essentials of nursing research: Appraising evidence for nursing practice (Edition 9). 2017. Philadelphia: Wolters Kluwer.
31. Andersson BT, Christensson L, Jakobsson U, Fridlund B, Broström A. Radiographers' self-assessed level and use of competencies-a national survey. Insights Imaging. 2012;3(6):635-645.
32. Wahlgren L. SPSS by degrees (Edition 3). 2012. Lund: Student literature.
33. Vanckavičienė A, Macijauskienė J, Blaževičienė A, Basevičius A, Andersson BT. Assessment of radiographers' competences from the perspectives of radiographers and radiologists: a cross-sectional survey in Lithuania. BMC Med Educ. 2017;17(1):25.
34. The Swedish Society of Radiographers, SSR (2008). Profession code of ethics. Retrieved from http://www.swedrad.se/da_foreningsdoc/