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Development of a questionnaire to explore Swedish radiographers' experienced need for additional post-registration knowledge in their profession

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Abstract

Introduction: The rapid and continuous technology development in radiology departments is seen globally. Swedish radiographers experience high workloads and difficulties in retaining colleagues and have few opportunities to develop the profession. It is therefore important to gain insight into radiographers' own perspectives of this concern for professional development in a national survey; however, the topic seems sparsely investigated. The aim of this pilot study was firstly to explore Swedish radiographers' experienced need for additional post-registration knowledge in their profession and opportunities for clinical advancement based on their everyday work, and secondly to generate items for a questionnaire.

Methods: Eight radiographers with diverse clinical experiences were interviewed. The interviews were recorded, then transcribed verbatim and analyzed using manifest content analysis. The empirical data was used for formulating questionnaire items.

Results: Three categories were found in this pilot study; Need to deepen previously learned knowledge; Need for mandatory educational program regulated by the law; Organization of education and clinical implementation of further knowledge

Ten items were generated from empirical data on a 10-point Likert scale which was pilot tested. Open-ended questions were formulated for each item, and demographic questions were added to obtain background data.

Conclusion: The results and opinions in the selected informants show a probable need for and wish of further education which could be done on a national scale through a quantitative questionnaire study, of which this study is the basis for.

Introduction

Education and clinical progression for radiographers at advanced level are expressed as important issues, both for development of the service provided from medical imaging[1-4] and for opportunities for professional development.[5-8] Radiography programs vary globally regarding educational level, professional scope and clinical training, which might influence the education offered and the opportunities for advancement in the clinical role.[9]

This study focuses on to explore Swedish radiographers' experienced need for additional post-registration knowledge and opportunities for clinical advancements. Their education is a three-year-long program at bachelor level, and the professional scope covers diagnostic imaging and interventional radiology.[10] Swedish registered radiographers' education covers both the technical and nursing aspects, subsequently qualifying them to independently perform examinations in diagnostic imaging, being responsible for patient care during examination, and to administer pharmaceuticals during examinations. In comparison with European standards,[11] radiotherapy is not included in their professional scope. Nuclear medicine is only a small part of the content in the education, since in Sweden other professionals, explicitly biomedical analysts specializing in physiology, mostly work in nuclear medicine. In Sweden, 'radiographer' is a protected professional title, but radiographers do not have the exclusive right to professional practice within a defined area of activity. In Sweden it is not specified which professionals that has the required competence to work with ionizing radiation or what education is required.[12]

There are uncertainties about the future of Swedish radiographers' professional role and practice, due to few opportunities for clinical advancement. There is also a shortage of radiographers as a result of low numbers of graduated radiographers during the last 40 years.[13] In 2020, there were 3715 radiographers employed in the Swedish health care system, and shortages of radiographers were reported from all county councils.[14] Until 2035, 160 radiographer bachelor graduated are estimated per year. Due to an increased population base with need for care, the demand for radiographers is predictable to increase by 15%, and to ensure a balance between supply and demand, 500 more radiographer bachelor examinations are expected needed in 2035.[15]

There are courses available at master's level, including technology and methods for different modalities, such as magnetic resonance imaging (MRI), computed tomography (CT) and positron emission tomography (PET)/CT. It is possible to combine courses for a master's degree, and a few universities have a complete master's program for radiographers. Postgraduate education in medical abdominal ultrasound is presented regularly at one university,[16] leading to a clinical role performing ultrasound examinations and, after clinical education and further education, also the possibility to use contrast media and perform interventions, including writing full interpretative reports.[17] Globally, radiographers' work at ultrasound units differs depending on the regulations and other requirements in each country,[17-21] and in most countries, writing independent signed reports, that is, performing diagnostic work, is not so common.[22]

A government investigation in Sweden in 2018 stated that there was a shortage of courses in radiography on advanced level,[23] which means level 7 in accordance with the European Federation of Radiography Society (EFRS)'s benchmarking of radiography education.[24] This investigation also concluded, based on the available courses, that it was not possible to introduce a specialist degree at advanced level in radiography.[23]

Previous research about radiographers' advanced practice, mainly from the national context of the United Kingdom (UK), describes radiographers' work with image reporting,[4, 6, 25, 26] performing examinations and interventions that traditionally are performed by radiologists, such as computed tomography angiograms (CTA)[7] and nephrostomy exchange.[27] Radiographers in the UK can also advance to consultant radiographers.[28-30] This development of healthcare professionals in the UK was initiated as a result of national policies for building a better healthcare sector[31] and the recognition of a shortage of radiologists.[32] Moving into other professionals' areas of practice can be seen as role extension into new professional fields, though, this can lead to tensions between different professionals in the workplace.[32] Nonetheless, earlier studies about radiographers' advanced practice showed improved breadth and depth in the professional practice and increased professional knowledge and hence professional recognition, [33] and experiences of enhanced professional status and interprofessional collaboration with other professionals in the healthcare sector.[4, 29]

We have not found studies that describe Swedish radiographers' vision of the future regarding development of their professional role, or their experienced need of knowledge at advanced level beyond their clinical experiences. Nor have we found national policy documents or directives describing or outlining advanced clinical practice and education for Swedish radiographers. A national questionnaire might be a path forward of understanding Swedish radiographers' own experiences of their everyday work and their opportunities for professional development and clinical advancement. However, since the field is sparsely investigated a pilot study is needed to construct items for a questionnaire.

The aim of this pilot study was firstly to explore Swedish radiographers' experienced need for additional post-registration knowledge in their profession and opportunities for clinical advancement based on their everyday work, and secondly to generate items for a questionnaire.

The research questions were:

- What additional post-registration knowledge do radiographers need in their everyday work?
- What content is needed in education at an advanced level?
- How do Swedish radiographers wish that advanced education, in their field, could be arranged?

Methods

Study design

A qualitative design with data collection through individual semi structured interviews were chosen to generate items for a questionnaire.

Item generation

Through interviews with radiographers in Sweden, a purposeful sampling of data could be reached. The process of selection and conducting interviews of these radiographers can be described in three phases.

First, seven heads of radiology departments were asked about their willingness to nominate radiographers for an interview study. The radiology departments were geographically dispersed in Sweden and of assorted sizes. These seven individuals received by email a description of the study and criteria for participation. Each of the seven individuals were asked to nominate two to five suitable radiographers for participation in the study. The criteria for selection for the study were radiographers that work 50% or more of their working hours with one modality and a spread in age, gender, and working experience as a radiographer. The selected radiographers should be reflective and have an interest in the subject for the study. The selected radiographers were asked orally, by the person who nominated them, about their interest in participating in the study. The seven department heads then sent the interested radiographers' email addresses to the research team.

Second, written information about the study was sent by e-mail to eighteen nominated radiographers. Eight radiographers agreed to participate in the study (see Table 1). The nominated radiographers at two of the selected departments (D and E; see Table 1), could not find time for an interview due to the high workload.

Third, the interviewees selected a suitable time for the interview. All interviews were conducted and recorded by the first author (LL) via Zoom video conferencing software. The interviewees were at their workplaces during their interview and had permission to take time for the interview during their work shift.

Table 1. Overview of sampling procedure for the study

Nomination of interviewees by department heads	Number of nominated radiographers	Number of interviewees
A	2	2
B	2	1
C	2	1
D	2	0
E	3	0
F	3	2
G	4	2

The interviewees' median work experience as radiographers was seven years (range 2.5–27). Median interview time was 27 minutes (range 22–38). The interviewees' main working areas in radiography were conventional methods (N = 2), CT (N = 2), intervention (N = 1), PET/CT (N = 1), mammography (N = 1) and pediatric radiography (N = 1).
The interviews, recorded through Zoom video conferencing software, were transcribed verbatim. All members in the research team transcribed interviews (LL, five interviews; MB, two interviews; and JK, one interview). The quality of the interviews was discussed regularly in the research team throughout the period of data collection.

The interview guide

The interview guide, with four questions, was constructed by the research team from the aim and research questions of the study. To determine the appropriateness of the interview guide's content in the initial stages, findings were analyzed from three interviews to evaluate correlation with the study aim. Based on this information, a minor revision was made to the interview guide, by combining two questions in the first version of the interview guide into one question instead. The research team decided to include all eight interviews in the study. After the above-mentioned minor revision, the questions in the interview guide were as follows:

- Describe an occasion in your professional practice when you needed additional knowledge.
- If you needed additional post-registration knowledge now, which areas would you like to deepen your knowledge to be able to work in a better way?
- If you were to plan for education at an advanced level for radiographers, how would you organize it?
- Do you have something more that you want to describe about education at an advanced level for radiographers?

Data analysis

Data were analyzed using manifest content analysis[34, 35] First, the interviews were read several times to attain an overview of the data. Then, in accordance with accepted principles of qualitative content analysis[34, 36] meaning units were identified, condensed and sorted into codes (N = 25). Thereafter, these codes were sorted by their similarities and

differences into 14 subcategories. Finally, the subcategories were abstracted, and the manifest content was interpreted, resulting in three categories[34, 36]) which became the findings of the interview data (see Table 2). The first author (LL) did the analysis, and the other authors (MB and JK) did a member check of extracts from the data.

The items for the questionnaire

The generated items were evaluated by examining their content and language, and correlation with the aim of the study, to learn about Swedish radiographers' need for further education and knowledge. The measurements in the questionnaire were constructed as a Likert scale and a 10-point scale was chosen to reach a high sensitivity. Because the small empirical data open-ended questions were added to the questionnaire.

Content validity testing Eight additional radiographers evaluated the preliminary questionnaire. To recruit participants for this test, purposeful sampling was used to guarantee an equal distribution of participants in terms of age, sex, years in the profession and breadth of experience. This pre-test was also examined for plain language, as well as evaluation of scale and formulation of questions.

Ethical considerations

The Helsinki declaration was followed, and ethical approval was obtained from the Ethics Review Authority of Sweden for the study (No 2021-05042).

Results

Item development

In the following, the three categories from the analysis of the interviews will be presented with citations from the data.

Table 2. Overview of subcategories and categories

Subcategories	Categories
Subcategories (N = 5) Deepen knowledge in 1) medical subjects 2) diagnosis of radiographs 3) practical application of technology 4) practical application of radiation physics and radiation safety 5) connection between anatomy, pathology and technique	**Category A:** Need to deepen previously learned knowledge
Subcategories (N = 6) Need for additional post-registration knowledge in 1) hybrid methods, for example, PET/CT 2) radiological interventions (RI) 3) magnetic resonance imaging (MRI) 4) pediatric radiography 5) specialized modality-based knowledge 6) task shifting (role extension)	**Category B:** Need for mandatory educational program regulated by the law
Subcategories (N = 3) 1) Desirable organization of education on an advanced level 2) Barriers to access to other courses in related subjects 3) Barriers in organization and work culture	**Category C:** Organization of education and clinical implementation of further knowledge

Category A: Need to deepen previously learned knowledge

The participants expressed a need to deepen knowledge and understanding in medical subjects for enhanced understanding of the methodology for image production/radiological interventions for improving patient safety, Interviewee 9 described a situation *"… an acute aortic dissection… it looked a little strange so… I had to start manually and there was a dissection in the entire aorta from the valves in the heart, the aortic arch and all the way down."*

A need for deeper understanding about interpretation of radiographs was also articulated for facilitating cooperation with radiologists, qualitatively better examinations and possibilities to improve patient flows in diagnostic imaging as Interviewee 7 explained how it could be learned in practice, *"…if the opportunity is there, sit in with the resident physicians when they are getting instruction… We are the first ones to view the images… it's a good thing if you can do the diagnostics…a deeper understanding of the diagnostics…shorten a process.".*

Technological knowledge and practical application of technology was an area where the participants expressed a need to deepen their knowledge learned from the basic radiographer education. This was explained as important for patient safety, particularly at examinations with non-standardized methodology. Similar experiences were described about theoretical knowledge and practical application of radiation physics and radiation safety. In-depth knowledge in technology, radiation physics and radiation safety were also important for ease of cooperation with other professions. This was also mentioned in the interviews as a key area for securing patient safety, as Interviewee 6 explained *"… worked with physicists in a different way… been able to adjust machines and change the examinations [protocols] on the machine so … less radiation dose to the patients and I could have spoken their [physicists´-] language".*

There was additionally a need for deeper knowledge about the connection between anatomy, pathology, and technical aspects to be able to perform qualitative examinations and to cooperate with other professions during image production/radiological interventions, interviewee 6 explained the development of clinical knowledge after a course in image review, *"now I see a fracture more easily...I look at the images in a different way... a greater understanding of what the images lead to, have better motivation to take images, can see more of what is needed... to get a good image and for the doctors to then make the diagnosis...a radiologist...should make the decision, but you can consult them on a different level..."*

Category B: Need for mandatory educational program regulated by the law

The participants described that some modalities in radiography were sparsely taught in Swedish radiography educational programs. Theoretical knowledge about PET/CT, MRI, RI

and pediatric radiography was thinly represented in the content of the radiography educational program which impeded practical learning in these are, as Interviewee 2 stated *"… when it comes to nuclear medicine and gamma cameras it feels like you are not so up to date on the camera technology and the array of examinations…, because that is not what you normally encounter as a radiography student during a couple of days of clinical education."*

In the interviews it was explained that in clinical work there was a need for diverse theoretical levels of radiographers' clinical knowledge for improving the quality of work conducted and being able to work in a more evidence-based manner. Another reason was the supervision of students and colleagues. Radiography education at an advanced level was therefore recommended to lead to modality-based specialization, as Interviewee 1 explained *"We need to specialize more…the profession becomes more interesting…I hope to see more radiographers earn a master's degree and choose an area to specialize in; …would … improve the way we work…will also become more evidence-based than…today"*.

Education leading to role extension was expressed to be important for increasing the attractiveness of the profession. It might also lead to a higher degree of responsibility and excellence for those radiographers who undertake this type of education. Role extension in this national context was suggested to lead to review images within conventional methods. In RI, role extension could, for example, involve the changing of nephrostomy catheters. Becoming a radiographer performing ultrasound examinations and writing reports after postgraduate education was also suggested as an alternative. Role extension was also expected to improve effectiveness and quality in the radiology departments as Interviewee 4 explained. *"… have the opportunity to gain experience…it is possible at some hospitals for radiographers to…changing nephrostomies. … sonographers… depend…on which physicians are working…and their interest in and personal attitudes... it could be incredibly good; you should feel that you are growing, that you are capable and can take on responsibility… you want to feel that you are competent and that you have specialist knowledge".*

It was found in the interview data that not all radiographers in radiological departments need a master's degree, but some postgraduate education in radiography is desired by most of the radiographers due to technological and medical developments. The informants stated that this could be obtained through university/college courses and/or through education in clinics.

Category C: Organization of education and clinical implementation of further knowledge?
The participants described that for those radiographers who want to achieve an academic level, it is advantageous if the universities offer whole programs on an advanced level in specific modality-based areas. Campus-based education was considered to increase interaction and exchange of experiences between the students, but distance learning might facilitate participation and provide opportunities to combine studies and work. Clinical

exchange between different clinics and clinical study assignments was identified as beneficial for extending clinical knowledge.

The courses offered in a master's degree did not represent all modalities. It was also difficult to obtain information about the courses and information about how to combine courses from different universities to attain a master's degree in radiography.

The participants reported that there was a need to be eligible to apply for a course on profound knowledge of improvement, organization and leadership, interprofessional teamwork and pedagogy, because there was a lack of education in these subjects in radiography educational programs.

In the interviews it was remarked that the organization, culture, and workload made it challenging to achieve development opportunities for those radiographers who wish to attain a master's degree. The informants stated that there was low interest in this kind of development among managers in radiological departments, as Interviewee 4 described *"...there should be an interest from that quarter [the management of the clinic] ... when they know that there is interest in increasing competence.... they should see... educational opportunities...must do it in your own leisure time and not get paid... we all experience it when we want to further our education ....and to take advanced courses."*

Radiographers who had a master's degree usually did not attain changed responsibility or new clinical functions. The findings in this study indicate that one reason might be that there was no clear description of advanced clinical level in radiography, in either national or local policy documents. The introduction of specialist employment and opportunities for clinical advancement might ease such development. The culture within radiographers' own profession with no propensity for conducting postgraduate education was also hindering, as Interviewee 1 explained *"We [radiographers] are bad at finding out things for ourselves... often a method supervisor and … the head of the section who are often physicians...they have a more active role in this than we do... We [radiographers] seek information mostly within the department, not outside"*

Result of content validity testing and finalizing of the questionnaire

After content validity testing, it was confirmed that the reformulated items remained consistent to the aim of the study. Demographic questions were added to obtain background data, and this procedure resulted in a definitive version of the questionnaire with twenty-two items.

Discussion

Three categories were found in this pilot study; Need to deepen previously learned knowledge; Need for mandatory educational program regulated by the law; Organization of education and clinical implementation of further knowledge.

Radiographers' need to deepen previously learned knowledge

The participants in this study expressed a need to deepen formerly learned knowledge, to strengthen both quality of examinations and patient safety. An earlier study concerning Swedish radiology departments has shown that lack of communication and knowledge, both internally and externally, can increase risks for patient safety incidents,[37] indicating the importance of radiographers' access to knowledge they need.[38] As for proactive work, collaboration and sharing of clinical knowledge, internally and externally, has been highlighted as important for the radiological examination to increase patient safety.[38]

None of the informants mentioned the concept of Continuing Professional Development – CPD and it was not explicitly asked for in the interview guide. In Sweden, CPD or equivalent is not mandatory for either employers or employees, as it is in other European countries. [39] A recent government investigation has just proposed that all licensed Swedish professions in healthcare should have mandatory continuing education [40] ,which then can be a system that would meet the needs that has emerged.

Need for mandatory educational program regulated by the law

The findings in the interviews indicate that some areas in radiography were thinly taught in radiography education. EFRS states that radiography study programs on bachelor level can vary between 180 European Credit Transfer and Accumulation System (ECTS), 210 ECTS and 240 ECTS. [39] Our finding in the interviews might indicate that a three-year radiography program (180 ECTS) does not cover extensive knowledge about all modalities within this field.

For improving the service provided to the healthcare sector, findings in the interviews illuminate that there is a need for modality-based specialization regarding the quality of work conducted and strengthening patient safety. In a public inquiry it was also concluded that from a clinical perspective there is a need for this type of specialization;[23] however, the recommendations within the inquiry did not include additional post-registration education at the master's level. The reason was that the content in a modality-based education was not broad enough for continuing professional education at master's level.[23] Instead, modality-based courses on advanced level and internal clinical education were recommended.[23] One reason might be that there are no national directives outlining possible advanced clinical roles where these have been beneficial for development of radiographers' professional role.[28]

The recent government investigation has also just proposed an introduction of a new national system where the government finance education at advanced level in university/college to enable licensed Swedish professions in healthcare to study part-time,[40] which then may increase patient safety.

Organization of education and clinical implementation of further knowledge

Mentioned earlier, a better alternative for Swedish radiographers is the possibility of becoming specialized radiographers,[13] which our findings also indicate might develop the profession and provision of service to the healthcare sector. However, there is a need to develop courses at advanced levels at university/college which correspond to all modalities in radiology departments.

The findings in the interviews indicate that there is a need for further knowledge in related areas, such as improvement in knowledge, supervision and leadership. However, an earlier Swedish government investigation did not include the need for further knowledge in these related subject areas.[14] Some obstacles identified in the interviews for development of an advanced level in radiography are in line with earlier results.[13] Moreover, lack of radiographers leads to high workload in the radiological clinics. Therefore, there is a risk that radiographers' professional work will be impoverished and become like assembly-line work.

Findings in our study also illuminate that the organization and culture in some radiological departments does not encourage advancements for radiographers. This can also be seen from an organizational perspective as healthcare having become organized more from a business perspective than from the perspective of the professionals.[41]

The findings in the interviews gave suggestions for organizations of further education for maximum participation. The Interviewees stated a need for and wish of further education through university/college courses and/or through education in clinics. However, they experienced a low interest from the management to encourage and provide conditions for education. The reason behind this is not clear, as this study only provided the perspective of radiographers. Therefore, a further study with some interviews with department heads could be advantageous to get an economic view of the problem.

Based on our interviews, it seems that both deepen previously learned knowledge (for example the concept of Continuing Professional Development – CPD) and education at advanced level at university/college are requested, grounded on the informants' own experiences in their everyday work.

Methodological considerations

Credibility was strengthened as the interview guide was corrected after three interviews, to ensure correlation to the aim of the study. All interviews were conducted while the Interviewees were at their workplaces. This is not optimal for feeling free to talk about their work and work conditions, which might have affected the credibility of the data. There might be a slight risk for insider bias, since all authors of this paper are radiographers.

This is a pilot study with the limitations of the small number of participants; however, the Interviewee was allowed to talk as long as they desired to ensure data saturation, and all Interviewee were Swedish radiographers representing all common methods in radiology departments, which ensure dependability of the study. Some of the radiographers who first

showed interest in participation found it hard to find time to conduct an interview due to the high workload. It would also have been advantageous if the Interviewees had work experience with all modalities. The empirical data might be limited and therefore it would be advantageous to add the opportunity to write free comments in the questionnaire.

Confirmability was strengthened through member checking of the other authors (MB and JK) during analysis process, and the robust presentation of the results together with appropriate quotations. All authors were involved in the analysis process which is another strength.

With the eight additional radiographers evaluating the preliminary questionnaire the transferability of the study was strengthened. The final questionnaire is included in supplementary materials, *Supplementary materials The questionnaire,* with the purpose of increasing the validity and reliability for this study. This questionnaire was used in the published study [42] where the Swedish radiographers' perceived need for additional post-registration knowledge in their profession and their need for education at advanced level was investigated.

Conclusion

The results and opinions in the selected informants show a probable need for and wish for further education which could be done on a national scale through a quantitative questionnaire study, of which this study is the basis for.
Implications for practice: The empirical data in this pilot study have been used to construct a questionnaire with twenty-two items to explore Swedish radiographer´s need for knowledge at advanced level in a national survey.

Statements and Declarations

The authors declare no funding and no conflict of interest.

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