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Systematic Review

Phenomena of radiography science - A scoping review

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ABSTRACT

Introduction: The purpose of the study is to clarify the domain of radiography science. The main goal of science is building knowledge and developing ideas and theories that explain, predict, understand or interpret the phenomena investigated. Each discipline has its own perspective to view and study the phenomena of interest. The disciplinary perspective enables researchers in radiography science to reason and conceptualize phenomena, but it can also restrict them. The aim of this review was to investigate phenomena that are at the core of the discipline of radiography science.
Methods: This study used a scoping review as the method. A systematic search was carried out in the databases: Science Direct, Pubmed, Cinahl, and Scopus. The selection of articles was conducted by pre-determined inclusion and exclusion criteria for the title, abstract and full text. After the exclusion process, fourteen articles were selected for a final review. The articles were analyzed with inductive content analysis.
Results: From the articles, 117 research interests were identified; these were merged into 17 categories and further into six main categories. The main categories represent the phenomena radiography science investigates. The phenomena are: the radiographers' profession, clinical practices in diagnostic and therapeutic patient pathways, safe and high quality use of radiation, radiographic technology, discipline, management and leadership of radiography professionals
Conclusions: Radiography science has a conceptual structure of its own that needs more investigation. Radiography science researches distinctive phenomena and specialized knowledge, common to researchers from different traditions and subspecialties thus justifying its existence.
Implications for practice: Investigating the core phenomena of interest in radiography science can support researchers in the field to focus their research and to develop the concepts of radiography.

Introduction

The purpose of this study is to clarify the domain of radiography science. Central to the discipline of radiography science is the identification of a research focus not covered by any other discipline. Academic disciplines have specialist knowledge regarding their focus of research. These are the natural phenomena, processes, materials or other aspects of concern on which member of the discipline focus their attention.[1,2] An academic discipline has 1) a community of scholars 2) a domain, where members of the community focus their attention 3) a shared history and traditions 4) a conceptual structure 5) a mode of inquiry 6) a specialized language and 7) a curriculum.[1–4] Not all disciplines have all these characteristics but the more characteristics a discipline has, the more mature it is. Legitimate members of the discipline are of a certain profession or scholars with particular academic education or merits.[2,5] In order to belong to a certain group one needs to speak with same specialized language.[1,5] Disciplines that consist of a strict group of scholars with a well-defined content and agreement about methods tend to have stronger identity.[5] Radiography science fulfills, for the most part, the criteria of an academic discipline.[6,7] Radiography science is heterogeneous and fragmented into three subspecialties that are sometimes referred as disciplines: diagnostic and therapeutic radiography and nuclear medicine.[8–11] Many paradigmatic issues remain unsolved and there is still some debate about the name of the discipline.[12] Sorppanen[13] suggests that the name of the radiography

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discipline should be clinical radiography science, to underline the connection of the discipline to the work of clinical radiographers. In Australia and North America the name of the discipline is "medical radiation science" and in most European countries "radiography". Academic disciplines may present varying features in different parts of the world but are recognizable as the same discipline with dominant assumptions about ontological and epistemological issues.[1,4]

Background

The main goal of science is building knowledge and developing ideas and theories that explain, predict, understand or interpret the phenomena investigated.[14–16] Phenomena are observable or unobservable objects, events or processes of scientific interest.[14] The goal of every discipline is to advance understanding of the phenomena, accumulate a body of knowledge, and document it in the form of scientific publications.[3] Scientists propose hypotheses or theories and test them through controlled methods. Other scientists then evaluate the results critically[17,18]. Sciences can be classified into basic sciences or applied sciences.[19] Another classification is that of descriptive and design sciences. Descriptive science aims to describe reality by establishing facts and causal laws about natural and social systems. Design sciences are not concerned with how things are, but how they ought to be in order to attain goals. They have some instrumental relevance to some professional practices and arts.[20] The development of radiography science originated from the clinical practice of radiographers, the rapid changes in technology, role development and the need for evidence based information in decision-making.[6] Its theoretical core is built on knowledge from various fields.[6,21]

The epistemological question is that of the nature of knowledge and truth.[4,22] How scientists construct knowledge is determined by the disciplinary perspective from which they perform their research.[23] The disciplinary perspective enables researchers to reason and conceptualize phenomena, but it can also restrict them. The nature of radiographic knowledge is associated with the natural sciences and humanities.[24] At one end is the positivist epistemology of the natural sciences and at the other end the human and social sciences in an interpretative framework.[25]

The research focus in radiography science has been studied by Sorppanen.[13] The key concepts were studied through the concepts of nursing science. Three main research foci for clinical radiography science were determined, these were also the basic concepts of the science. The concepts were: the radiographer's work within health care, the physical and functional environment in health care, the cultural and cognitive environment; as well as health and illness. The European Federation of Radiographer Societies (EFRS)[8] state that the focus of radiography research should be on clinical practice and optimal application across imaging and radiotherapy subspecialties. More specifically on technological development, patient care, education, leadership and the management of radiography professionals. The principal goal of radiography research should be in evidence-based practice and the continued development and improvement of imaging and therapy services for the benefit of the patient.

The aim of this review was to investigate phenomena that are at the core of the discipline of radiography science. The objective was to explore the key elements of the phenomena and to describe their essential characteristics.

The research question was:

What are the phenomena radiography as a scientific discipline investigates?

Methods

Search strategy

This was a scoping review conducted according to the Prisma statement for scoping reviews.[26] A systemized search was made in the databases: Science Direct, Pubmed, Cinahl, and Scopus. The following terms were used for the title, abstract and keywords (where applicable): radiography AND (research focus OR research paradigm OR research interest) and with "radiography science" and "medical radiation science".

The inclusion criteria for the selection of studies were that they were peer reviewed articles in the English language, articles identifiable as radiography research either by publication (radiography journals) or the author's affiliation to radiography, studies pertaining to the research of the discipline of radiography science or research interests, and finally those addressing the research question. Inclusion criteria were also set as to the quality of the studies; those studies that did not receive a minimum of 80% yes answers in the appraisal checklists were excluded. Book chapters, editorials and other non-peer reviewed articles were excluded. Publication year limitation was not set. The searches were carried out in December 2020.

Study selection and critical appraisal

Database searches produced altogether 742 articles (Fig. 1). The selection was first made at the title level, then at the abstract level and finally at the full text level, using the inclusion and exclusion criteria. First author (ST) performed the title level exclusion, and also removed duplicates. Articles selected at the abstract level (n = 127) were downloaded onto a Rayyan QCRI application,[27] which is a tool for the data processing of systematic reviews. ST and the third author (EM) carried out the abstract level exclusion. ST and EM blindly selected from the included articles those for full-text reading. Thirteen articles were tentatively selected for full-text level inspection. References and citings in the 13 selected articles were screened in order to find undetected literature. Another eight articles were found. Altogether 21 articles were selected for full-text level inspection. After reading the full texts and assessing whether they met the criteria and addressed the research question, fifteen articles was selected for critical appraisal. Any disagreements were negotiated and resolved by discussion.

Critical appraisal of selected studies was performed using the Joanna Briggs Institute (JBI) critical appraisal tools.[28] Studies were of different designs and for the appraisal we used the following checklist tools: analytical cross sectional, case series, qualitative search, systematic reviews and text and opinion. We used a case series checklist for the Delphi studies as appropriate, as JBI does not have a separate checklist for Delphi studies. ST and EM completed the quality assessment independently and the results were compared. In three articles, the authors disagreed on one item in the checklist, but differences in the evaluations were resolved through discussion. After the quality assessment one article was omitted from the review, due to the poor quality of article. Ultimately, fourteen articles were selected for the review. In literature reviews there are potential ethical issues regarding the selection of the articles and the interpretation of the results. We prevented these issues by using a systemized method and two reviewers.

Data extraction and synthesis

Data from the selected articles were extracted and synthesized by using inductive content analysis. Inductive content analysis is a suitable analysis method when prior knowledge of the

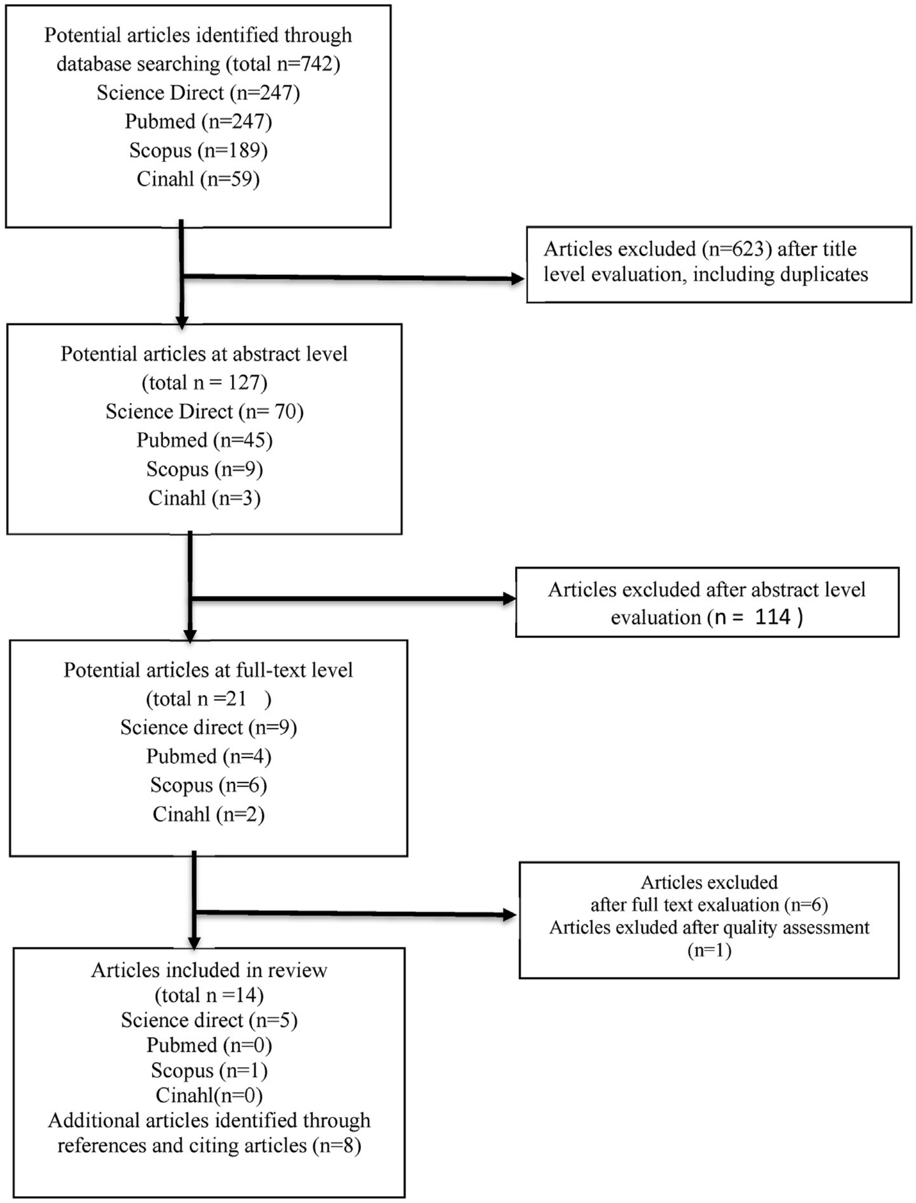

Figure 1. Flow chart showing the selection of articles.

phenomenon studied is fragmented. Basic inductive content analysis includes phases of data reduction, data grouping and formation of concepts that can answer research question.[29,30] When used in synthesizing data in literature reviews, it follows the steps of organizing data for sub-categories, categories and main categories.[29,31] In the data extraction, the year of publication, aim, participants, data collection, analytical methods and key findings were tabulated. In the synthesis, the research question was used to guide the content analysis.[32] The selected meaning units for the analysis were statements expressing potential areas for research in radiography science. These meaning units were further simplified and categorized to subcategories, categories and main categories.

Results

Articles selected for the review were from Australia (n = 4), UK (n = 4), Finland (n = 2) and Sweden (n = 1). Three of the articles were from more than one country: Finland and Sweden (n = 1), UK and Australia (n = 1), Norway and Australia (n = 1). Articles were for the most part descriptive in their study design. One article was considered to be an analytical study and two theoretical. The articles represented various methodological approaches: three were nonsystematic reviews, three were systematic reviews, four were Delphi studies, two were concept analysis, one quantitative and one study applied mixed methods. Publication year ranged from 1996 to 2019 (Table 1).

Altogether 33 researchers were involved among authors of the articles. Six articles were from the combined field of radiography,[12,33–37] three from diagnostic radiography[38,39,40] and five from radiation therapy.[41–45] No articles from the field of nuclear medicine were found. In general, the selected articles dealt with the research methodology of radiography science, radiography as a discipline, research in radiography in different countries, professionals' attitudes toward research, concepts of radiography and research interests and potential areas of research. Most of the articles

Table 1
Articles selected for review (n = 14).

Authors and year	Country	Design (method)	Aim	Key findings
Challen & Kaminski & Harris 1996	United Kingdom	Descriptive (survey)	to determine attitudes and activities of radiography clinicians regarding research	46 potential research areas (not identified). Highest priority in dose measurement and dose reduction. Other areas: role extension, new techniques, human resource issues
Adams & Smith 2003	Australia	Descriptive (nonsystematic review)	to introduce qualitative research methods and to sketch one possible framework for future qualitative work in radiography research	Proposed framework for qualitative research: intra-professional issues: professional practice, organizational issues, future development, education priorities, professional behavior, professional role, territory, identity and EBP. Inter-professional issues: collaboration between professionals, inter-disciplinary practice, patient-centered care, clinical practice, health delivery, patient's perception and experience of radiographic practice, high quality care.
Ahonen 2008	Finland	Theoretical (concept analysis)	To manifest the attributes of the concept of radiography in health sciences and to compare them to the attributes identified inphysics and technology. To define the concept of radiography in health sciences	knowledge base in radiography consists of: technical and human elements (patient care and technological performance), processes, use of radiation.
Reeves 2008	United Kingdom	Descriptive (nonsystematic review)	To examine the role of the consultant radiographer in providing potential research leadership and outline possible avenues for research	potential areas for research: patient experience and outcomes to patient (in medical imaging), care pathways, social phenomena of the profession itself, radiography consultant role and experiences of those professionals.
Ahonen 2009	Finland	Theoretical (concept analysis)	to view the content of radiographer's work in health care, as well as related terminology in Finland	clinical radiography and radiotherapy consists of: (1) technical radiation usage and radiation protection, (2) patient care and service and (3) service for a health care context. Seamless combination of technical usage of radiation and radiation protection, and of patient care and service is the core, aimed at serving the health care field as part of a multi-professional teamwork. It is guided by individuality-respectful client-orientation and interactive collaboration, and implemented as a process, which consists of planning, implementation and evaluation phases. CRR is characterized by responsibility for safety and optimizing decision-making.
Cox, Halkett & Anderson 2009	Australia	Descriptive (Delphi study)	to provide an understanding of the research areas that are of interest to radiation therapist in Australia	A total of 410 research interests identified. They were categorized to three groups: staff issues: “Radiation therapist education”, “Staff interactions”, “Workload”, “Management”, and “Diversification, recognition and other professional issues” (58,3%); technical issues (28,9%): “Accuracy of patient positioning”, “Techniques/Equipment”, and “Manual handling”; and patient related issues (12,9%): “Patient communication”, “Patient education”, and “Psychosocial support.“.

Table 1 (*continued*)

Authors and year	Country	Design (method)	Aim	Key findings
Malamateniou 2009	United Kingdom	Descriptive (nonsystematic review)	to critically review historical events that highlight research in radiography andprovide insight to requirements specific to research in radiography	Highest priorities: optimization of diagnostic image quality, dosimetry, radiation dose reduction, role extension, new techniques, human resources issues, innovations, treatment and effectiveness of different diagnostic procedures.
Cox, Halkett, Anderson & Heard 2010	Australia	Descriptive (Delphi study)	to prioritize the Research Areas that RTs thought were most important	categories identified as most import: 1) Imaging in radiation therapy. 2) Symptom management. 3) Diversification recognition & other professional issues. 4) Management & staff issues. 5) Accuracy of patient positioning. 6) Techniques/equipment.
Halkett, Cox & Heard 2012	Australia	Descriptive (Delphi study)	to (1) identify patient-related research priorities in RT 2) describe similarities and differences in rt responses to patient care research priorities	areas rated as most important in patient-related researcher in rt: reducing and managing treatment side effects, educating patients, identifying which patients would benefit from cone-beam computed tomography, evaluating biological modelling tools in relation to patient outcomes and examining how waiting lists affect patient anxiety levels.
Snaith 2013	United Kingdom	Descriptive (systematic review)	to review the radiography profession in terms of these publications to explore the evidence base and identify its evolution internationally	articles focused on: clinical practice, dose, QA, skills and role, education, research methods, history, profession and policy.
Egestad & Halkett 2016	Norway and Australia	Descriptive (Delphi study)	To prioritize the research areas that RTs thought were most important	top 5 categories: 1) Treatment plan and radiation doses 2) Radiation therapist education 3) Accuracy of patient positioning 4) Psychosocial support/communication 5) Techniques/equipment
Halkett et al., 2017	Australia	Analytical (Mixed methods)	1) determine the current extent of RTs research participation; (2) evaluate the impact of involvement in research projects on career perceptions (3) explore RTs perspectives on which research topics require investigation and (4) identify perceived benefits and barriers to research participation.	research interests for RT's: treatment technique, patient focus, patient outcomes, technology, imaging, workforce issues, education, treatment planning, treatment accuracy, department efficiency, radiation safety, complementary medicine,
Metsälä & Fridell 2018	Finland and Sweden	Descriptive (Systematic review)	to give an insight into radiography as a science and discipline from the viewpoints of a) type of knowledge interest and b) a methodological approach/design.	studies focused on: radiographer role development and education, image interpretation, comparing imaging/radiotherapy techniques and modalities, and post processing developing protocols mostly in MRI. Workflow development, economic evaluation, the implementation of guidelines or processes, improving quality and patient safety, radiation risk and optimization, patient care in radiography, side effects, and adverse events. Describing and identifying phenomena and examining patients' feelings, their perceptions about examinations and examination risks, interactions between radiographers and patients, and patient safety. There were also studies on radiographer students' experiences and attitudes, radiographers' perceptions about technical developments e.g. in CT and MRI, optimization and image quality, service or professional

(*continued on next page*)

Table 1 (*continued*)

Authors and year	Country	Design (method)	Aim	Key findings
				development, pedagogy in radiography education, continuous professional development, radiography practice and communication, workplace wellbeing, and management.
Lundgren & Andersson & Lunden 2019	Sweden	Descriptive (systematic review)	to explore the nature and the current state of radiographic research, written by registered diagnostic radiographers in Sweden	doctoral and licentiate research foci: Structural factors (organizational change, impact of new technology, organizational workflow, impact on professional practice and instrument development and testing), clinical radiography (patient experience, parent experience, participants undergoing different examinations and interventions), radiographic technology (image protocols, image quality and inter-observer agreement), pedagogical approaches (information strategies and learning outcomes). Interdisciplinary nature of radiography research

were published in radiography journals: *Radiography, Radiographer, European Journal of Radiography, Journal of medical imaging and radiation sciences and Journal of Medical radiation sciences.* One article was published in the *European Journal of Cancer Care.*

One hundred and seventeen potential research interests were identified from the articles. These were further merged into 17 categories and these further into six main categories (Table 2). The main categories represent the phenomena that are in the core of radiography science. In the following chapters, all the main categories will be described in more detail.

Radiographers' profession

The main category designated as the radiographers' profession was formed from the categories of profession, role development and education. The common denominator for the phenomena is that they revolve around issues of the radiographers' profession. These include the education,[12,33,37,41,44,45] skills[37] and competences[40] required to practice the profession. Research in radiography science focuses on professional identity,[33] social phenomena of the profession[34] and continuous professional development.[12] Research about the role development of radiographers, such as image interpretation or advanced practices, was reported to be an important area to study.[12,33,34,37–39,41]

Clinical practice in radiography

The main category of clinical practice in radiography was formed from the categories clinical practice, processes and protocols, outcomes and effectiveness and patient care. Clinical practice within radiography refers to the agreed-upon means of delivering services in health care contexts. In the review of Swedish dissertations, clinical radiography was the most studied research field.[40] Adams and Smith[33] state that research needs to be focused on clinical practice for the benefit of patient and community needs. Patient care was seen as an important research area in both diagnostic imaging and radiation therapy.[12,33,35,36,45] Palliative care was also seen as an important topic in radiation therapy.[45] There were also research interests in psychosocial support,[41,44] patient communication[41,44] and patient education.[41,43,44] Clinical practice can be studied through patient experiences and feelings[12,33,34,40,43,45] as well as perceptions and opinions, since the phenomenon does not exist outside the interaction of radiographer and the patient. Developing and implementation of protocols, guidelines and processes is a part of clinical practice in radiography.[12,40] Research into procedures and their effectiveness[39] and the outcomes of those procedures for patients forms one part of this phenomenon.[34,35,43,45]

Safe and high quality use of radiation

The main category of safe and high quality use of radiation is formed from the categories safety, quality and radiation usage and dose optimization. Technical radiation usage[36] and studying aspects of radiation safety is pivotal in radiography.[36,45] These include investigating the risks of radiation,[12] dosimetry studies,[37–39,44] optimization of radiation doses[12,38,39] and biological effects of radiation.[45] In radiation therapy, the relationship between treatment planning and late side effects of doses is also important.[42,44] Patient safety is the subject of studies[12] and the occupational health and safety of radiographers is also an area of interest[45]; these are often interlinked with the safe use of radiation. Quality assessment[37] is a broad area of interest including elements of improving quality[12,37] in any radiography clinical practice. Of specific interest to diagnostic radiographers is that of image quality in various imaging modalities.[39,40]

Technology in radiography

The main category of technology in radiography is formed from the categories technology in imaging, technology in radiation therapy and technological development. The technological performance of radiographers[35] is one of the key concepts in radiography science. Technological performance can be studied through different imaging techniques[12,39] post-processing techniques[12] or radiation therapy techniques.[12,33,41,42,44,45] Future technology research, technology development,[12,33,39,40] the impact

Table 2
Example of subcategories (all subcategories not present), categories and main categories.

subcategories	Categories	Main categories	
professional identity	profession	radiographers' profession	Phenomena in the core of radiography science
professional competence			
continuous professional development			
radiographer role development	role development		
image interpretation			
advanced practice			
radiographer education	education		
student experience and attitude			
pedagogical approaches			
radiography practice	clinical practice	clinical practice in radiography	
clinical practice			
evidence based practice			
developing and implementation of protocols	processes and protocols		
implementation of guidelines and processes			
information infrastructure in radiography department			
outcomes to patients in medical imaging	outcomes and effectiveness		
outcomes to patients in radiation therapy			
effectiveness of imaging procedures			
patient centered care	patient care in radiography		
psychosocial support			
patient feelings and experiences			
parent experience			

Table 2 (*continued*)

radiation safety	safety	safe and high quality use of radiation	
patient safety			
occupational health and safety			
side effects and adverse effects			
improving quality	quality		
image quality			
quality assessment			
radiation risk	radiation usage and optimization		
radiation optimization			
dose reduction			
imaging techniques	technology in imaging	technology in radiography	
post processing			
radiotherapy techniques	technology in radiotherapy		
intensity-moduladed radiotherapy			
stereotactic radiotherapy			
technology development	technological development		
impact of new technology			
innovations			
instrument development and testing	radiography research methods and instrument development	discipline of radiography science	
research methods			
research priorities	research priorities		
structural factors	features of radiography department	management and leadership	
department efficiency			
workforce issues	human resources in radiography		
management			
staff interaction			

of new technology[38,40,42,45] and innovations[39] could be areas of interest within this phenomena.

Discipline of radiography science

The main category of the discipline of radiography science is formed from the categories radiography research methods and instrument development and research priorities. There were only a few articles mentioning research interests in this category. These included instrument developments and testing,[40] research methods [37]and research priorities.[12]

Radiography management and leadership

The main category of radiography management and leadership is formed from the categories, features of the radiography department and human resources in radiography. The common denominator for topics in this category is that they are related to radiography or radiotherapy organization either as structural factors[37] or as management issues.[12,41,42] These include for example workflow in the departments,[12,40] workload[41,42] or workforce issues.[38,39,45]

Discussion

We can identify what phenomena are and what they are not by categorizing them and describing their essential characteristics.[46] In the phenomenon of clinical practice in radiography, the essential characteristics were the different diagnostic and therapeutic procedures performed within a healthcare context. They were the processes and events that occur in a specific environment: in diagnostic and therapeutic units. Clinical practice aims to improve the life of patients and how patients perceive these procedures and how care is given is therefore important area to study. Diagnostic and therapeutic procedures are carried out by professionals, whose education, competences and professional development formed another specific phenomenon of interest to study. This includes the management and leadership of these professionals.

Diagnostic and therapeutic procedures are conducted by using some form of radiation in the electromagnetic spectrum. In the phenomenon of safe and high quality use of radiation, both safety and quality issues were often linked to radiation usage. Radiation usage was mentioned mainly in a healthcare context but the phenomenon itself is broader. Technology, different imaging devices and radiation therapy equipment, are objects of interest in radiography research. In the phenomenon of technology in radiography, interest is not merely on the objects but also on the events linked to technological performance and development.

Phenomena represented here were mostly in line with Sorppanen's[13] research foci. The professional issues and duality (patient care and technology) of radiographers work and the use of radiation were present in this study as well. Nursing science concepts: caring, environment, health and illness, that Sorppanen reflects upon, do not clearly emerge from our data, indicating that radiography science has conceptual structure of its own that needs more investigation. European Federation of Radiographer Societies (EFRS)[8] statement on research focus was confirmed but it is clear that it needs to be defined in more detail. The clinical practice of subspecialties, technology development, patient care, education, leadership and management were present in the descriptions of the research phenomena that researchers in the field also suggest. However, the phenomena are more complex and versatile than indicated by the EFRS statement. It is important to identify the phenomena that are at the core of the discipline in order to place the focus of the research on the most important topics.

Following the categorization of sciences by Niiniluoto,[20] radiography science, in addition to its other features, aims to describe reality and it has intentional developmental approach similar to design sciences. Radiography science is a discipline created for diagnostic imaging, radiation therapy and nuclear medicine.[6] It blends the use of healthcare technology, radiation and clinical practice in imaging and therapy procedures. It aims at addressing a problem neglected by other allied sciences. Radiology uses medical imaging to diagnose and treat diseases. Medical physics seeks to develop efficient and safe diagnosis and treatment methods for human diseases, but does not investigate the processes and events happening in these procedures from patients' perspective. Nursing science studies health and nursing care. In radiography, care is not seen as nursing but more of service-oriented care for the short period a patient is in a diagnostic or therapeutic unit. The disciplinary perspective that Boon and Van Baalen[23] and Boon[14] refer to is in the service delivered in diagnostic and therapeutic procedures and the phenomena surrounding it. Perspective can help researchers in the field identify phenomena and research problems but it can also be restrictive in a way that the phenomena in radiography are often reduced to merely being the viewpoint of the profession and this prevents us looking beyond this perspective.

The knowledge base in radiography science can be derived from the natural sciences and humanities as proposed by Castle[24] and Hammick.[25] However, it is a unique combination and more directed to practice. It is clear that radiography science has a community of scholars who conduct research in this field and has phenomena on which they focus their attention. Conceptual structure in the discipline is still evolving; this was demonstrated in the coding phase of statements when we noticed that concepts with same meaning were used inconsistently. It is recommended that more conceptual analysis be conducted on the basic concepts of the science. In this study, we identified the core phenomena, and it is therefore possible to derive the basics concepts from these phenomena.

The epistemological question was that of the nature of knowledge and what can we know.[4,22] What can we know about these phenomena? Knowledge in radiography science can be obtained from different sources; it is in the mind of a radiographer (professional experience, opinions), in the mind of the patients (experiences, perceptions), in observations of the phenomena (e.g. social behavior, communication) and in quantitative measurements (e.g. physical measurements of radiation or statistical measurement of effectiveness). Knowledge in measurements can be objective but in many cases the knowledge is subjective (opinions, feelings) and value laden (e.g. effectiveness).

Potential biases and limitations

The authors used a blind review process for abstract and full-text level exclusion and a systematic search strategy to control biases. The high level of consensus among the authors in the selection process reduced the bias; all the authors were also experienced in publishing scoping reviews. The validity of the results is limited due to the variability in methodological approaches and research designs of the selected studies. Three of the selected articles were nonsystematic reviews[33,34,39] however, we still decided to include them because they were peer-reviewed and well argued. Three of the articles[41–43] were reports from the same Delphi study but from different perspectives. Our study did not search for the unpublished research, which can lead to a publication bias.

Concepts in radiography are unestablished (e.g. the name of the discipline). The lack of unified concepts in radiography might have had influence on the literature searches. This was demonstrated in the way that half of the selected articles were found through references and citing articles. Not all the critical appraisal tools that we used were fully suitable for the types of studies we assessed, since JBI does not have a tool for Delphi studies.

Conclusions

The image presented here of the phenomena indicates that radiography science has a conceptual structure of its own. It is currently a very profession orientated science. At the core is the profession of radiographers and the phenomena surrounding it. Radiography science has distinctive phenomena that it researches and specialized knowledge that is common to researchers from different traditions and subspecialties, thus justifying its existence. It is possible to expand the disciplinary perspective to look at the phenomena from a broader viewpoint than that of professional interests, to make it a more mature discipline and possibly in the future a reference discipline[3] from which other disciplines can derive knowledge. Phenomena in radiography science should be investigated further in order to develop the discipline. They could be studied empirically for example by exploring researcher's views using a larger survey or by observing the phenomena in practice.

Conflict of interest

There are no conflicts of interest. The authors have not received funding for conducting this study.

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