



Gradual transition

Bottlenecks and task sharing in diagnostic imaging

Kyrre Lekve
Dorothy Sutherland Olsen
Arne Martin Fevolden

Report 46/2013

NIFU

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Report: 46/2013E

Published by: The Nordic Institute for Studies in Innovation, Research and Education
Address: Post-box 5183 Majorstuen, N-0302 Oslo.

Commissioned by: The Norwegian Society of Radiographers
Address: Rådhusgata 4, 0151 Oslo

Preface

This report has been commissioned by The Norwegian Society of Radiographers. The aim of the report is to examine whether task sharing between radiographers and radiologists is a practical method by which to solve bottlenecks within diagnostic imaging. The report is based on a literary study of national and international literature in the field, and on interviews with practitioners involved in Norwegian task sharing projects, and with patient and employees' organisations.

The report has been prepared jointly by Kyrre Lekve, Dorothy Sutherland Olsen and Arne Martin Fevolden, with Kyrre Lekve as project leader. We express our gratitude to informants who devoted time to meet us and to share their viewpoints and experiences with bottlenecks and task sharing within diagnostic imaging.

Oslo, 26 November 2013

Sveinung Skule
Director

Liv Langfeldt
Acting Research Director

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Summary

This report has been commissioned by The Norwegian Society of Radiographers (NSR). The aim of the report is to examine whether task sharing between radiographers and radiologists is a practical method by which to solve bottlenecks within diagnostic imaging. The report is based on a systematic search of national and international literature in the field, on interviews with practitioners involved in Norwegian task sharing projects, and with patient and employees' organisations.

The main conclusion is that bottlenecks are difficult to solve without radiographers taking over a number of the radiologists' duties. We recommend that measures be undertaken to introduce shared responsibilities, and make suggestions as to how this process should be carried out.

Use of diagnostic imaging has a long tradition within medicine from the introduction of X-rays at end of the nineteenth century to the introduction of Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) commencing in the 1970s. Ultrasound is based on radio waves beyond the human hearing range, and has been in use for the last fifty years. More recently, completely new techniques have been developed, for example Positron Emission Tomography (PET) together with combinations of several imaging techniques – so-called hybrid modalities.

The report shows that a number of bottlenecks exist within diagnostic imaging. A recurring theme in reports from our informants is that medical diagnostic imaging is a bottleneck although no official data exists (for example, numbers on waiting lists) which describe these bottlenecks more precisely. We recommend that such statistical information be compiled.

Many informants consider that the bottleneck within diagnostic imaging is the result of a shortage of radiologists. In the report we point out that, in principle, it is possible to increase the supply of radiologists by educating a higher number, but it would take many years before results were manifest. Similar results could be achieved by recruiting radiologists from abroad, or by outsourcing the interpretation and reporting of images to institutions abroad. However, the shortage in numbers of radiologists is a problem throughout the Western world. We conclude that there is reason to assume that the potential for increasing the number of radiologists is limited. It will therefore be necessary to consider other methods of increasing access to diagnostic imaging if these bottlenecks are to be removed. It is also possible to think that by various means the authorities could limit use of diagnostic imaging. In the current Norwegian debate, the climate hardly exists for restricted use of diagnostic imaging. The third manner by which bottlenecks can be solved is to undertake sharing of responsibilities. We consider that the potential for finding a cure to this problem is to undertake a new distribution of duties.

A sustainable and successful redistribution of duties related to diagnostic imaging is not something which evolves naturally. Our interviews and studies of the literature suggest that a number of conditions are required to be fulfilled in order that a redistribution of duties shall be successful. A consensus culture is required to be established leading to an agreement on protocols, and how patient safety and quality shall be safeguarded. A division of responsibilities must be carried out based on mutual respect for the various professions' skills. Work requires to be organised such that the professions cooperate in their focus on the common problem. Circumstances must be such that individual skills can be developed. The division of responsibilities must be defined objectively including clinical problems (for example, fractures), selected modalities (for example, X-rays and ultrasound/sonography), and parts of the body (for example, the extremities for X-rays and the upper abdomen for ultrasound).

We recommend that conditions are determined whereby a new division of responsibility can be established, and that this is done in accordance with the principles outlined in this report. This process must be based upon respect for the diverse professions' scientific characteristics, and implemented in such a manner that this is based on mutual confidence, resulting in a joint recognition of those duties which can be organised in a new manner. Increased professional overlap should be ensured whereby the various professions work jointly in the progress and interests of the patient.

We recommend that various methods are employed in order to establish consensus around routines, procedures and the organisation of duties related to diagnostic imaging in order to establish reliability in the treatment of patients. More attention should also be devoted to documenting quality in duties related to diagnostic imaging for all professional groups involved.

We conclude by stating that there is a potential for revitalizing the entire field of diagnostic imaging. An improved division of responsibilities will enable radiologists to devote more time to activities such as research, which receive little attention today. For radiographers, an improved allocation of duties will result in new professional challenges. Our informants also state that an improved organisation of responsibility within diagnostic imaging will ultimately be to the benefit of patients through shorter waiting times. Further, the quality of diagnostic imaging can be improved through better use of skills of all professions involved in the field.

1 Introduction: Diagnostic imaging and bottlenecks

The traditional division of responsibilities between radiographers and radiologists has been that the radiographer prepares the patient and produces the diagnostic images while the radiologist undertakes the interpretation.¹ This division of responsibilities² has been based on the particular skills of the two professions – radiologists as doctors with diagnosis, prognosis and treatment as their special field, and radiographers as technologists with patient-care, apparatus and radiation hygiene as their special field.

1.1 Division of responsibilities under pressure

In spite of the fact that this division of responsibilities has long traditions and is solidly based in the training schemes of the two professions, it has nevertheless been subjected to pressure related to technological development. While this technological development has resulted in radiographers being able to take more and better images and more quickly, the same development has also resulted in radiographers using more time to describe more and detailed images. This imbalance has been further increased whereby by the demand for safer and more scientific diagnostics and method of treatment has resulted in increased demand for diagnostic image services. This has resulted in a shortage of radiologists in Norway as is also the case in other countries, something which has created bottlenecks in several patient treatments.

In Norway, as well as internationally, a number of measures have been commenced to remedy the shortage in the numbers of radiologists. Attempts have been made to train more radiologists; attempts have also been made to restrict unnecessary use of diagnostic image services. Further, efforts have been made to transfer certain work tasks from radiologists to radiographers. Even though there are major challenges related to all these measures, it is the latter which has shown to be the most controversial. With the aid of so-called 'reporting radiographers', one transgresses the established professional boundaries and changes the professional basis for medical practice. Consequently, this measure has become an issue in a heated debate in hospitals, the scientific press and academic journals. It is also this measure with which this report is essentially concerned. In the discussion, we investigate the extent to which a new division of tasks between radiologists and radiographers is a reasonable approach to solving bottlenecks in diagnostic imaging.

1.1.1 *Various types of task sharing in diagnostic imaging*

Task sharing is a recognised process which has been practiced since the dawn of medical science. Einar Vigeland (2010) has described the historical background for the development of task sharing. It can be useful to distinguish between three different ways in which the new organisation of tasks has proceeded.

Horizontal task sharing. This type of task sharing arises when tasks are transferred between staff at the same level. Within diagnostic imaging, this particularly occurs when other specialist surgeons utilise diagnostic imaging outside the traditional radiological department. Cardiologists in particular utilise ultrasound techniques in studying hearts; oncologists have taken into use a number of image diagnosis techniques in the treatment of cancer. Horizontal task transfers are not normally controversial, particularly because this generally concerns specialists in one field (radiologists) entrusting functions to other specialists in another (cardiologists and oncologists). The question of

¹ We use the terms 'produce' and 'describe' pictures to refer to taking and interpreting radiology images of all types.

² In this report, we use the concept of 'division of responsibilities' as a general term for transfer of tasks, job transfer, task sharing and similar concepts.

competition between two different specialist fields and training does not therefore arise. One particular area, which may partly be referred to as horizontal task sharing, is where ultrasound has been taken into use in pregnancy supervision, both by general practitioners and midwives. This was controversial when first carried out by the latter.

Vertical task sharing. When radiologists transfer tasks to other professions with a shorter training – such as they have done throughout history (see below) – this is generally referred to as vertical task sharing. It is this type of task sharing which has dominated the discussion and which has been the most controversial in recent years. Controversy concerning vertical task sharing is normally well outside the field of diagnostic imaging. Administration of medicines, the right to approve sickness leave and to write prescriptions, are examples of controversies in other areas of medicine.

Diagonal task sharing. In preparing this report, The Nordic Institute for Studies in Innovation, Research and Education (NIFU) found it objective to operate with three types of task sharing. One of these goes 'diagonally' – via horizontal task sharing. We have observed that radiographers, including those both with and without supplementary training, have worked closely with specialist physicians outside the traditional radiology departments. Within this cooperation, different forms of task sharing have emerged which are not normally encountered outside the radiological departments. Radiographers have thereby had opportunity to carry out tasks outside the radiological departments which they have not had inside these departments. This clearly puts pressure on radiographers to be able to carry out such tasks, also within the traditional radiology departments.

It is important to emphasise that task sharing may be both formal and informal. Under certain circumstances, radiographers can take over tasks from radiologists but without this being considered as normal practice. One example can be that radiologists take the responsibility for diagnostic tasks during night shifts. Elsewhere, task sharing can be considered as a part of normal practice. One example of this is the use of sonographers (reporting ultrasound radiographers) where ultrasound analysis is a part of their normal work tasks.

1.2 Professional groups and task sharing in diagnostic imaging: A historical overview

Norway was an early user of X-rays. The first X-ray apparatus was taken into use just a few years after Wilhelm Conrad Röntgen discovered roentgen radiation (X-rays) in 1895 (Poppe & Aakus, 1995a, b). In 1897, The Diakon Institution Hospital (today, Lovisenberg Diaconic Hospital) acquired its first X-ray machine. In 1898, The National Hospital (today, Oslo University Hospital) acquired its own apparatus in 1898 following the establishment its newly established Roentgen Institute. In the ensuing years, many Norwegian hospitals were to acquire X-ray machines. Even though Norwegian hospitals had commenced to utilise X-ray equipment relatively early, only a few departments in the hospitals undertook X-ray treatment. It was primarily doctors in the surgical and children's wards where interest was aroused in the new technology. This was due the fact that this made skeletal treatment easier. Concerning children, this provided a less rigorous alternative to existing treatment. Doctors in other departments remained sceptical for a long time towards X-ray treatment.

In the initial years of radiological treatment, the X-ray apparatus was primarily used by doctors who both took and analysed the images themselves (Lone et al., 1995; Poppe & Aakhus, 1995b). Gradually, the doctors received assistance from what was to become a new professional group – X-ray nurses. From ca. 1910, X-ray nurses commenced to take over an increasing number of tasks from the doctors. This included operation of the equipment and responsibility for taking images and carrying out radiation therapy (X-ray treatment). From 1940, special courses (further education) were introduced for X-ray nurses, including 8-month training in diagnostics, therapy and X-ray physics. Roentgen nurses were nevertheless not satisfied with this training and attempted to convince the

health authorities that they had to organise a more comprehensive course. The authorities considered, however, that the role of the nurses was at the bedside and preferred to establish a new group of specialists who would take over the tasks carried out hitherto by the X-ray nurses – radiographers.

The first official entry of Norwegian radiographers commenced in 1970 when Oslo municipality established the first radiography school in Norway (Lone et al., 1995). The school was run by X-ray nurses and the students largely comprised X-ray nurses who achieved the qualification of radiograph after 1 ½ years' supplementary training. Interest in this form of training gradually declined, and was superseded by a three-year course with importance attached to technical and clinical subjects. At the same time a number of new courses were introduced at the National Hospital in Oslo (1973), Tromsø (1973), Bergen (1975), and elsewhere. In 1981, the academic status of radiography was enhanced when the vocational schools were designated as colleges. It was further required that in addition to educational courses these colleges should carry out R&D. This academic reorientation continued, and radiography is now a 3-year university/college course leading to a bachelor degree. Radiographers also have the opportunity to undertake further education courses leading to a Master's degree and a Ph.D. in health subjects. Chairs associated with radiography have also been established at the colleges.

Parallel to the academic development of courses for X-ray nurses and radiographers, doctors also experienced that their professional field developed and they encountered increasing requirements for education and skills (Skjennald & Tausjø, 1995). During the first years, formal requirements were introduced, but these were to change when, in 1917, the Norwegian Medical Association adopted a set of specialist regulations for radiologists including the requirement of one-year's service at an X-ray department in order to be called a specialist in 'X-ray examination and treatment'. In 1933, these requirements were increased to two-years' service at an X-ray department and one year in an internal medicinal or surgical department. In 1965, The Norwegian Society of Radiographers (NSR) proposed a new specialist education which included 4-years' service in an X-ray department as well as conditions for completing the course. This has continued in step with technological development; today special education in radiology comprises 5-years' practice at a radiology department and 256 hours obligatory course participation. This results in a minimum of 12 years' study being required to educate and train a specialist doctor in radiology (Vigeland, 2012).

1.3 Method and structure of the report

This study has been commissioned by The Norwegian Society of Radiographers (NSR) which has clear professional interests associated with task sharing. For NIFU, it has consequently been important to select methods which ensure that the NSR has not been able to influence the content of the report in an inappropriate manner. First of all, NIFU determined that the report should be based on research principles. Secondly, the research group has systematically acquired information independently and prior to any discussion with the commissioning institution. Thirdly, the initiative regarding the design of the study, procedures, methods, selection of subjects for interview, and all other methodological considerations have originated with NIFU. NIFU has also attached importance to the broadest possible basis upon which conclusions shall be drawn. No differences of opinion arose between the NSR and NIFU related to the research problems.

The data in this study has been acquired from literature, conversations with persons central to the subject, and interviews with a number of individuals, both practicing radiologists and radiographers, and from others with an interest in diagnostic imaging.

1.3.1 The literature

The aim of our study of the literature was to obtain a better understanding of radiography as a specialised subject and as practiced in certain countries. Our findings from the literary study are given in Chapter 2.

The publications studied can be classified in two main groups:

1. Descriptive articles on task sharing in different communities where radiographers extend their area of responsibility.
2. Analytical articles on the quality of diagnoses provided by radiographers compared to doctors.

A common feature of these publications is that they generally relate to small groups in specific situations and where there is reason to believe that many local circumstances have contributed to the results as described. Consequently, we are not able to base our conclusions solely upon these articles.

We have examined Norwegian studies concerned with task sharing within the Norwegian health service, with importance attached to changes within the specialist area of radiographers and their work situation. We also investigated international publications in scientific journals. These searches revealed a number of articles on work practice among radiographers and radiologists. These included publications related to task sharing involving radiographers and various specialist groups in Norway, Scotland and Australia. Some studies of the quality of radiographers' diagnoses compared to those of doctors. These included a number of general studies on improving the efficiency of diagnostic imaging.

In addition to the articles which we have found, recommendations were also made by the NRF and informants, and from presentations at the Norwegian Hospital and Health Service Association conference on job sharing.³ The reference list in this report provides an overview of the literature consulted.

1.3.2 Interviews

One method used for data collection was interviews. This method is preferable when one is interested in the viewpoints of specific groups and includes their opinions and experiences. This is also a method which is particularly appropriate in revealing complex interactions, and for understanding the context within which activities take place. The descriptions which emerge in the interviews can be interpretations of events and situations where these arise in the dialogue between the interviewer and the informant (Kvale 1996) and provide an alternative to the more structured survey. The method is also known for providing informants with the opportunity to speak more openly about their work situation and personal experiences. Consequently, this method has been selected for this project.

We have selected informants during discussions with the Norwegian Society of Radiographers. The informants are not, however, a representative sample even though there is a reasonably broad coverage of the types of organisation which the informants come from. First and foremost, NIFU wanted to interview representatives from organisations where new approaches to the organisation of tasks had been introduced in recent years. An overview of the interviews is given in Chapter 4.

All interviews were recorded digitally and transcribed. A summary of the interview was sent to the informant for comments and suggestions.

A total of eight interviews were carried out and included six radiographers and two radiologists at five different institutions. All were willing to share their experiences. They provided us with comprehensive descriptions of their current work tasks, and explained the division of tasks and how this has changed

³ <http://www.nsh.no/script/InfoEnglish.aspx>

over time. They described the progress of patients, use of technology, task sharing and delegation of responsibility. In addition, all informants described their education and previous work experience, and discussed the advantages and challenges encountered with a change in work tasks based on their experience.

In a number of situations we have been shown the offices where the images were made. We have seen the programmes used by the informants in connection with patient treatment, image archives, presentation of images, and how descriptions and data of the diagnoses were archived.

The project group also carried out four interviews with institutions having a particular interest in diagnostic imaging including The Norwegian Radiologic Society, The Norwegian Society of Radiographers, The Norwegian Cancer Society, and The Norwegian Directorate of Health. Further, we had dialogue with the Board of directors of The Norwegian Society of Radiographers.

1.3.2 Structure of the report

In this chapter, we have given an introduction to the report and outlined the problem areas studied.

Chapter 2 describes trends within diagnostic imaging, nationally and internationally, and summarises the main literary sources.

In Chapter 3, we describe the various driving forces which result in bottlenecks within diagnostic imaging based on interviews and available literature. We summarise the available information concerning these bottlenecks. We conclude the chapter with a description of possible alternatives for removing the bottlenecks within diagnostic imaging.

Chapter 4 includes a summary of our observations through interviews with the organisations which carry out diagnostic imaging.

In Chapter 5, we summarise the circumstances which either encourage or hinder an objective division of tasks within diagnostic imaging. We also look at some of the interested parties involved in the field of diagnostic imaging.

In the final chapter, Chapter 6, we present our conclusions and recommendations based on the findings in the report.

2 Diagnostic Imaging in development

Task sharing is not a new phenomenon, neither is it particularly Norwegian. In several countries such as England, the USA and Denmark, task sharing involving radiologists and radiographers has proceeded over several decades. In Norway, an attempt has been made with a new division of responsibilities, but this development has been delayed and experience has been drawn from the experiments in the leading pioneer countries. Based on experiences with task sharing, there has been a corresponding growth of literature, both nationally and internationally. In this chapter we present an overview of national and international literature and the development trends.

2.1 International trends⁴

The majority of Western countries experience a shortage of radiologists and where the causes are apparently the same. On the one hand, development within established fields such as conventional X-ray and the introduction of new modalities such as ultrasound, computer tomography (CT), magnet tomography (MR) and positron emission tomography (PET) have resulted in the application of diagnostic imaging expanding to cover new patient groups and diagnostic problems (Vigeland, 2010). On the other hand, medical practice has progressed towards increased use of diagnostic imaging in order to satisfy the demand for evidence-based diagnostics and diagnostics which may be subject to tests. Together, this has provided the basis for an enormous increase in the demand for diagnostic imaging services. When, in addition, image material has become more comprehensive and complex – and the radiologist's task of analysing the images has become more time-consuming – the basis is laid for bottlenecks in most countries.

Even though the shortage of radiologists is a feature of most industrialised countries, this has not resulted in any common solution for these nations. In many countries, this shortage has not even resulted in joint solutions within the national borders. The international trend is rather that most countries, to varying degrees, have attempted to remedy this shortage of radiologists by adopting one or more of the following strategies (see Chapter 3.4):

- transfer of responsibilities from radiologists to radiographers
- restrict the unnecessary use of diagnostic image services
- educate and train more radiologists.

The United Kingdom is perhaps that nation where one has gone furthest in attempts to remedy this bottleneck in diagnostic imaging by transferring responsibilities from radiologists to radiographers (Vigeland, 2010). This transfer has followed a number of patterns. Transfers have been of a general nature in as much as the British hospital has allowed radiographers to indicate fractures and other pathological manifestations in X-rays. These markings (red dots) were intended to relieve the radiologist's workload and assist clinicians in the preliminary diagnosis prior to the analysis by the radiologist. The transfer of responsibilities has also been associated with the specialisation that commenced in the 1970s where specially qualified radiographers – sonographers – were allowed to carry out ultrasound analyses. To begin with, these sonographers had to have their analyses approved by a radiologist. Since 1987 however, they have been permitted to make independent reports of the results of their ultrasound examinations. Finally, the transfers have also been linked to post-graduate education through a four-tier system where radiographers have the opportunity to undergo further training to become an 'advanced practitioner' or a 'consultant practitioner' This implied that to a greater degree they could undertake diagnostic tasks and carry out independent patient

⁴ NIFU has based this review of international trends partly on literature in Vigeland (2010), but essentially on information provided by informants who have been in contact with colleagues abroad.

consultations. It is radiographers in the U.K. who analyse advanced CT and MR images in defined areas.

A number of other countries have followed the United Kingdom and transferred responsibilities from radiologists to radiographers. However, in the majority of cases these countries have chosen to transfer fewer tasks, and in specially defined areas. Sonographers have been used in the USA over a long period and who carry out the majority of ultrasound examinations. In contrast to the UK, American sonographers have not normally been allowed to analyse the findings or to approve finalising of examinations by signature. On the other hand, a system of post-graduate training leading to 'radiologist assistant' has been introduced in the USA, something which has much in common with the British four-tier system.⁵ Use of the radiologist assistant has increased whereby many states have approved the practice and reimbursement is proportionate. Denmark has also followed the British system where, among other things, sonographers are permitted to carry out independent ultrasound examinations of the upper abdomen, and to allow radiographers with post-graduate training to report skeletal images. Denmark has also introduced training courses for radiographers in carrying out and interpreting CT images of the large intestine/colon in order to be able to cope with the significant number of examinations which would not be undertaken through screening with the aid of colonoscopy and those which have to be followed up when finds are positive.

Another strategy for coping with the shortage of radiologists is to restrict the unnecessary use of diagnostic imaging services. This strategy is expressed in a weak form and a strong form. In the weak form, this only refers to coping with the shortage of radiologists through restricting duplication and examinations which are clearly unnecessary. The majority of countries have expressed ambitions to restrict the use of diagnostic imaging services to areas where they contribute to establishing a more precise diagnosis. In the strong form, the radiologist is mentioned as being directly involved in the clinical evaluation of patients in order to find alternative diagnosis procedures and to restrict the use of diagnostic imaging services. This strategy is recommended by the Australian and New Zealand Radiologist Association, among others, as an alternative to the use of reporting radiographers. We have not found any studies which suggest that these measures have been particularly effective.

Bottlenecks in diagnostic imaging can be remedied by training more radiologists or by outsourcing radiology services to other countries. Most countries attempt this strategy to a greater or lesser degree. It is, however, difficult to educate and train a sufficient number of radiologists since such courses place demands on radiology resources and in addition place demands on doctors who are a scarce resource in other parts of the health service. None of the industrialised countries has been successful in meeting the demand for radiologists through education. Outsourcing radiology services to countries such as India has been attempted by hospitals in the USA among others. The volume of this outsourcing is not clear, nor to what extent it has been successful. Outsourcing is also a question which involves legal aspects and problems associated with working conditions and job situation (for example, social dumping).

2.2 National trends⁶

Few attempts have been made in Norway to transfer responsibilities from radiologists to radiographers. Some attempts have nevertheless been undertaken. Gjøvik University College and The Innlandet Hospital Trust carried out a trial project in 2007 involving further education in reporting sonography at Gjøvik. One class-year completed the course, but such strong opposition was

⁵ The British four-tier structure comprises four levels. At the lowest level we find 'assistant practitioner' who is an assistant to a formally trained radiographer – designated as 'practitioner'. The two levels above this are 'advanced practitioner' and consultant practitioner, who is a radiographer with supplementary training.

⁶ NIFU has based this summary of national trends partly on literary sources such as Vigeland (2010), but mainly on information supplied by informants who either are involved in, or have knowledge of, these initiatives.

encountered from the radiological community that the project was discontinued. In 2008, a second project was commenced at Oslo University Hospital where radiographers received training in standardised video recording of ultrasound investigations which was later described by radiologists. This project was less ambitious but has been continued at a national level. Levanger Hospital, with assistance of The Central Norway Regional Health Authority, has commenced a task-sharing project where sonographers have the final responsibility for reporting and signing, equivalent to that of specialist doctors.

Similar projects have been carried out outside the radiologic departments, including Oslo University hospital where radiographers have been offered courses in echocardiography. At a number of hospitals throughout the country, new projects concerning shared responsibility are being planned. Several of these projects are linked to training of reporting skeletal radiographers who can relieve radiologists by describing, for example, images of fractures. Other projects are related to training of radiographers to carry out stereotactical breast biopsies (SiV HF), or further education as a reporting sonographer. An unknown number of radiographers have undertaken sonography education abroad on their own initiative. Several of these carry out independent ultrasound investigations in both private and public institutions in Norway, among others at Curat Røntgen (a private chain of clinics).

The Norwegian Directorate of Health is in the final phase of preparing new national guidelines for use of diagnostic imaging involving muscular/skeletal illnesses.⁷ According to the Directorate's homepage, the new guidelines will contribute to the 'correct use of radiology' and to 'correct priorities being given to patients referred to an examination'. According to our informants, the first-mentioned has been considered more important than the latter.

2.3 Literature

A significant amount of national and international literature has emerged relating to radiologists and radiographers. This literature can essentially be classified into two groups: Social science literature which frequently examines distribution of responsibility in a professional-theoretical perspective, and experimental literature which shows the results of controlled experiments in task sharing. In the following, we present a brief summary of these two groups of literature.

2.3.1 *Social science studies*

We have examined professional publications on themes related to radiologists and radiographers. We searched on keywords for both English and Norwegian publications and grouped these by main subject area. This is not a systematic analysis of all publications related to the theme but is intended to provide an overview of the types of publication which are to be found and which aspect of the development stands in focus. Some publications consider the development of the professions while others are more focussed on changes in working conditions in the modern hospital.

Some studies are to be found concerning the development of radiology both as a subject area and as a profession (Forman et al., 2012; Gunderman & Brown, 2012; Kuhlman et al., 2011). These studies attach importance to the radiologist's role as doctor: how the radiologist has responsibility for the patient and must consider the diagnosis and treatment in its entirety. The importance of including the patient's medical history as a part of the diagnosis, not just interpretation of the images, is emphasised. Radiologists have noted that diagnostic imaging is increasingly used and that this requires new thinking (Vigeland, 2010).

The development of radiography as a profession is the theme of a number of studies, for example Nixon (2010). Nixon suggests that radiographers must themselves work towards increased

⁷ <http://helsedirektoratet.no/publikasjoner/bildedagnostikk-ved-ikke-traumatiske-muskel-og-skjelettlidelser/Sider/default.aspx>

professionalism and to breach the barrier whereby services can be integrated. Radiographers are encouraged to 'adopt a culture which encourages openness and participation, sharing of good practices and the valuation of education and research' (CoR, 1999).

Changes in the role of radiographers over time is the theme of a study made by Price and Masurier (2007). This is also a study from the UK and shows broad variations in the extent of the radiographer's role. Injection of contrast medium is a normal task and radiographers are involved in 'red dot schemes' at many places. These are situations where the radiographers signal suspect situations (red dots) such that the radiologist is able to locate these images and to respond more quickly to these. The study found that a large number of radiographers are active concerning describing or reporting finds from the images, but that there were large variations between the various medical areas (Table 1). In addition to the specialised areas (reporting fields) in the table, a further 28 areas were mentioned within which radiographers were active.

Table 1. Variations in the use of radiographers in different medical fields

Reporting field	Number of trusts where activity undertaken	Number of radiographers undertaking activity (WTE)	Trusts where radiographers report independently of a radiologist
Barium enemas	78 (44%)	175 (17 ^a)	15 (19%)
Barium meals	11 (6%)	10	1 (10%)
Chest	7 (4%)	14	3 (43%)
Mammography	38 (22%)	66 (10 ^a)	14 (37%)
Nuclear medicine	20 (11%)	24 (5 ^a)	8 (33%)
Paediatric	11 (6%)	26 (3 ^a)	10 (91%)
Plain film – appendicular	81 (46%)	172	72 (89%)
Plain film – axial	70 (40%)	159.5	62 (89%)
Ultrasound	146 (82%)	689 (9 ^a)	134 (92%)

^a Not stated by trust.

Source: Price & Masurier, 2007)

The study concludes that the radiographer's role has been under constant development: 'The scope of radiographic practice has widened significantly since the 1990s with radiographers now performing tasks which were once the responsibility of medical practitioners' (Price & Masurier, 2007 p. 27). Further, the survey shows that many of the new tasks have been gradually integrated and are now standard. The authors consider that there is reason to believe that this development will continue.

Potential solutions to the workload of radiologists is a theme in some studies where practical situations are analysed. The majority of these solutions are based on radiographers taking over some of the radiologist's work tasks. One example is that of Gibbs (2013) who analyses the development of sonography as a special field of study. The article describes how persons without medical education are used to solve the problem of increasing demand for ultrasound analysis by developing sonography as a specialised study area. Experienced radiographers can now undertake postgraduate studies in sonography enabling them to perform ultrasound examinations and to describe and interpret the results. Gibbs concludes that this role extension is something which needs to be considered by all professions and that existing regulations such as 'Professional statement of conduct' can restrict this development. She means that there is a greater need for adaptation of professions as a result of external circumstances and refers to actors, such as the political authorities, who have been more active in formulating regulations and demands to protect the public against unqualified staff. There is a difference between functioning as a profession and of being regarded or approved as a profession, and as Eraut (1994) found, there is frequently a resistance towards expansion of the work tasks from other groups who consider that they own the rights linked to particular tasks or a specific type of knowledge.

Some studies have looked at new ways in which work tasks are organised. For example, the Royal College of Radiologists in the UK has defined diagnostic imaging as 'teamwork' (RCR, 2012). They describe a process which comprises 'clinical imaging service delivery' where, in addition to supplying a service, contribute to innovations in patient care. They confirm the large increase in the use of diagnostic imaging and point out that this has resulted in changes in patient progress and several 'diagnostic and treatment pathways'. In addition to the increased number of patients, there are new requirements concerning treatment times and new technology which creates both new problems and provides new possibilities simultaneous to radiologists experiencing that they become involved in many areas and in interdisciplinary meetings as advisers. The report concludes that the health service must be more innovative in its work.

2.3.2 Experimental studies

There are few studies which compare the effects of task sharing between radiologists and radiographers (Forsetlund et al., 2013). We have, however, found some relevant studies which are commented here.

A Danish study (Buskov et al., 2013) examined how radiographers and radiologists interpreted 500 skeletal images from the Accident and Emergency ward at Bispebjerg University Hospital. They compared reporting radiographers with newly qualified radiologists and found that the former were right in 99% of cases, and radiologists in 94%. They discovered that reporting radiographers had more instances of 'overcalling' – that is that they signalled a suspected fracture but without that this was found. The study concluded that radiographers had confirmed that in this instance they were able to take responsibility for this task. 'Trained radiographers report accident radiographs of the extremities with high accuracy and constitute a qualified resource to help meet increasing workload and demands in quality standards' (Buskov et al., 2013 p. 58).

There is one Norwegian study of sonographers who had taken over ultrasound responsibilities from radiologists (Hoffman & Vikestad, 2013). They evaluated a pilot project which included training of experienced radiographers in the field of sonography (both formal training and local follow-up by a radiologist), and evaluate their ability to identify an abnormal case. Two-hundred and forty-four ultrasound examinations were carried out in three different departments (by radiographers/sonographers and radiologists). It was seen that in 95.1% of cases, the radiologists and the sonographers arrived at the same conclusion. In 99.2% of cases, the sonographers' responses were defined as 'best' or 'medium' quality by the radiologists; in 1.6% of the cases, the sonographers failed to find an abnormal case. The authors concluded that the sonographers had confirmed that they could distinguish between negative and positive findings in these ultrasound examinations and that they did not make more mistakes than the radiologists.

One unpublished evaluation of a Norwegian project (BR050601, 2011) also gave some interesting results. In 2009, a project was commenced where reporting radiographers within skeletal radiology at Oslo University Hospital (ARN/OUS) involving selected radiographers undergoing postgraduate training at Salford University, England. The course comprised a one-year study resulting in qualification as an reporting radiographer within skeletal X-rays. During the course of study and the following year, the radiographers were followed closely by their supervisors and mentors, which included radiologists. As part of the training, each radiographer interpreted and described 1500 skeletal X-ray examinations from the clinic, including examinations of child skeletons (300 cases) and axial skeletons. This was carried out whereby the radiographer constructed his own 'parallel descriptions' which were then compared to the official descriptions made by a radiologist. In 42% of the investigations, there were finds of relevant pathology, mainly fractures. Of all descriptions, 80% were found to be correct (true positive or true negative), without the need for changes in the text or content. Changes were made in the remaining description, although this were largely to language such that a total of 95.5% were judged as being correct. Changes in the findings were made to only

4.5% of the descriptions, corresponding to seven descriptions being assessed as false negative or false positive.

In summary, it is difficult to draw conclusions from just a few investigations although these show that in specific specialist areas the radiographer can carry out some ultrasound tasks which were previously carried out by radiologists with the same, or virtually the same, precision as the radiologists. It is important to mention that in all cases experienced radiographers were selected for these tasks, and that all received post-graduate training and follow-up by a radiologist in the training period.

The literature studied indicates that both radiologists and radiographers are fully aware of the large increase in the use of diagnostic imaging and the corresponding increase in the workload of radiologists. Both specialist groups are concerned with removing bottlenecks while simultaneously being concerned that their own special area or profession is well defined and contains clear guidelines. The studies mentioned in the above document attempts at transferring responsibility, and where those experiments have been evaluated, the results have been positive. All studies attach importance to the training of radiographers who were to undertake new tasks. In all cases, the experienced radiographers were handpicked for the task. All received post-graduate training and the majority had a planned practice period with close supervision by a radiologist. The studies reveal that there is a considerable number of potential areas where radiographers can undertake more tasks and more responsibility, but the dispersion of studies can indicate that there are many local factors which play an important role in a successful division of tasks.

2.3.3 Attitudes held by radiographers and radiologists

Some studies have attempted to present an overview of attitudes towards the various professional groups, how these have reacted to changes and trends within their profession. These studies have essentially employed questionnaires in order to obtain data (Forsyth & Robertson, 2007; Moran et al., 2013; Norsk Radiologisk Forening, 2008); some have been supplemented with interviews.

Radiologists focus on education of future radiologists (Norsk Radiologisk Forening, 2008) and hold the opinion that if it becomes the norm for radiographers to have responsibility for the interpretation of ultrasound, then ultrasound will assumedly be dropped from radiology training in the future. They also point to the fact that if radiologists are engaged with ultrasound only occasionally, then they will lose the ability to interpret such images. On this basis, radiologists consider that the boundaries of the radiology profession should be fixed while at the same time they see a need for more flexibility, not least since technological development has resulted in a considerable increase in the number of images, and that patient numbers also increase (although less so than the number of images) (Statens Strålevern, 2010).

Radiographers have a positive attitude towards new work tasks and see the possibility inherent in modern technology. They refer to an understanding that training within a profession has become increasingly multidisciplinary and consider that this is a good point in time for evaluating systematisation of the transfer of responsibilities, and preparing for more flexibility in some aspects of patient treatment.

One Australian study (Moran et al., 2013) considered attitudes held by radiographers using a questionnaire. They discovered that radiographers were concerned with further education and extra demands on quality assurance. They were also concerned whether changes would be voluntary – or not. In this article, the problem was described as ‘role extension’ – that is to say something which presents the radiographers with new challenges, and not something which increases flexibility in the process leading to a diagnosis. Importance was also attached to challenges by permitting more to become radiographers and to retaining good radiographers in their post.

These few articles do not provide a comprehensive picture, but suggest that both professions are clear about the need for change simultaneous to the existence of diverse views as to how this shall be achieved.

3 Bottlenecks and task sharing

In this report, NIFU has investigated bottlenecks and task sharing based on selected patient procedures where radiographers are involved. We have looked at examples within cardiology, ultrasound in breast cancer, examinations of the upper abdomen, and use of diagnostic imaging in orthopaedics. We have also looked at bottlenecks and task sharing within radiation therapy. In all cases, our informants have experienced bottlenecks, and in each specialist field there has been changes in radiographers' work tasks, largely as a response to these bottlenecks.

3.1. Forces creating bottlenecks within diagnostic imaging

During the last thirty to forty years a number of changes have occurred which, in combination, have contributed to bottlenecks arising within diagnostic imaging. In the following, a number of these development patterns are described based on information from interviews undertaken by NIFU.

While conventional X-ray is old technology, other modalities have been introduced within the last 30–40 years. CT – computer tomography – is also based on X-rays, and was introduced in the early 1970s. MRI – magnet resonance imaging – is based on radio waves and magnetism and was also introduced at the beginning of the 1970s. Ultrasound is based on radio waves outside the human hearing range has been used during the last 50 years. PET – positron emission tomography – is based on radiation techniques which involve radioactive isotopes. PET was discovered in the 1950s although was first perfected in the first years of the present century. PET scanners are expensive, and costly in operation. Today, there is a tendency to combine modalities – so-called hybrid modalities – for example PET and CT, or PET and MR.

3.1.1 Changes in technology

The new modalities such as CT and MRI (and PET) enable images to be made which were not possible previously. It is also possible to manipulate images such that details and associations may now be viewed which were not possible hitherto. The various modalities have different characteristics and diverse uses. A PET scanner enables cancer development to be traced in places which is difficult to observe with CT, for example on account of muscular tissue. Improved quality of PET and CT has made it easier to follow the development of a cancerous tumour. In addition to diagnosing cancer and determining the location of tumours, these techniques can also provide an answer to how cancer can spread and which organs are affected or are at risk of becoming affected.

The improved quality of images provides the basis for a more nuanced recommendations and treatment. This also applies to radiation therapy. Previously, radiation treatment was based on a coarse image which only indicated the approximate location of the tumour. Doctors calculated the concentration of the radiation based on the patient's body weight and estimated the size of the tumour. Radiation of healthy tissue was included such that one was certain that the tumour had been hit. Current image technology enables radiation treatment to be determined much more precisely. It is also possible to examine the images during treatment such that this can be adjusted accordingly.

Another area which was mentioned in connection with technological development is within cardiology. Techniques such as PCI, stents and balloons have provided cardiologists with a real alternative to surgical or medical treatment of blocked arteries. These alternatives utilise image technology to identify blockages and to determine whether the patient can be treated using stents or balloons.

One informant (a radiographer) summarised by stating that one consequence of technological development is that it assists in determining the correct treatment of the patient. Previously, one had to make a choice, see if this was successful, and possibly try another method.

Better and improved technological storage possibilities make it more relevant for video recordings of ultrasound investigations to be archived, thereby enabling a distinction between image-taking and interpretation. This allows for an improvement in the quality of the process, for example through subsequent controls. Ultrasound has traditionally been a 'real time' investigation where the production of images and the diagnosis proceed simultaneously. Consequently, there has been less opportunity to try other forms of task sharing within this modality. It is now possible to store ultrasound investigations on video. If there is any doubt about a diagnosis or description of an image, a qualified specialist can go back and examine the recording.

The most important consequences of technological developments can be summarised as follows:

- *Increased information in each image.* Image information in the modalities CT and MRI (and PET) is far broader than information in traditional X-rays and ultrasound. There is more detail to be considered when the images are to be interpreted (described).
- *Several images per patient.* As expressed by one of our informants: 'Previously, we had two or three images per patient. Now we can receive more than 1000 CT images per patient. We see this as an electronic stream of images on the monitor.'
- *The transition from X-ray to CT and MRI.* In the period 2002–2008, the overall use of radiologic investigations remained fairly constant at 900 per 1000 inhabitants, but there was a notable transition from conventional X-ray to CT and MR (Statens Strålevern, 2010). This is also confirmed by our informants. CT especially requires immediate reporting as in the case of brain haemorrhage, traffic accidents and cancer. A CT examination can take from three to 10 minutes before the image is sent to the doctor for interpretation. 'MRI is more meticulous but takes 20 to 40 minutes for an MR investigation' one informant states.
- *Easier to produce; more complicated to describe.* Improved technology has resulted in considerably improved images while technological development has made it easier to produce both more and better images. This development has also made it possible to see much more, and everything which can be significant for diagnosis and the treatment has to be described.

'We now see that one can go through an entire thorax in just one second. Ultrasound has developed simultaneously to CT and MR. When we began, none of us could even dream of what can be done today. We see more, and now we receive 1000 images of fantastic quality every day. There is more to describe. Each time a new modality comes, we see more; there is more pathology. Soon we will be down to the level of the cell; we are not far off.'

From surgery to less invasive methods of treatment. A number of informants mentioned that technology has created several alternative methods of treatment. Now, not all cardiologic patients require surgery or to be an in-patient over a long period. The same occurs with treatment of cancer. 'We do not need to operate on each and every suspect tumour in order to see what they are; we can see this from the images.' Improvements in radiation therapy techniques which are the result of increased image quality have also led to this being a more attractive treatment for many patients who previously would have undergone surgery. One informant expressed this: 'There have been developments in all hospitals following the transition from bed to day-treatment. Patients are not bed-bound so long and treatment time has been reduced. This puts pressure on diagnostic imaging; the patient must be examined immediately.'⁸

⁸ We do not know the reason why there is a desire to avoid operations – whether this is related to costs, or whether this is an ethical principle of the nursing staff (i.e. to reduce patient suffering).

3.2 'Political' and cultural changes

For many years, the field of medicine has become increasingly scientific; there are increased demands for documentation and evidence-based treatment. Diagnostic imaging emerges as a very solid form of documentation and the science of diagnostics easily results in more referrals. There is an increasing trend towards knowledge which can be authenticated later. 'Previously this was much more subject to the doctor's discretion; he felt the stomach of the patient. Now everything has to be substantiated. This implies that an increasing number will avail themselves of diagnostic imaging.'

3.3 Bottlenecks in diagnostic imaging

All informants were asked about bottlenecks, and all pointed to the interpretation of images as the main bottleneck. Areas where these bottlenecks were particularly manifest were during routine treatment which were downgraded on account of acute incidents. Some also mentioned delays due to administrative routines, i.e. that all letters are required to be sent via the post, and that a secretary is required to write the text dictated by a radiologist. Within the field of radiation therapy, it has been argued that there are instances where a lack of available treatment units has led to waiting lists. This applies particularly to palliative radiation therapy and treatment of lower priority. Reports have also been received of a shortage of oncologists who are able to interpret images of cancer patients.

The description of bottlenecks has been expressed in different ways. Some consider that there is a shortage of radiologists; others consider that technology is the cause of the bottleneck. If we consider work tasks, it is those tasks associated with the interpretation of images (description) where there is insufficient capacity to meet current requirements.

There are considerable geographical differences in the waiting time for different types of diagnostic imaging. Via the website 'Fritt sykehusvalg' (www.frittsykehusvalg.no) [Free Hospital Choice Norway], an impression is given of how this service can vary. For conventional X-ray and ultrasound, there are relatively short waiting times at most places, with 12 weeks at Egersund (X-ray) and 18 weeks at Nordland Hospital, Bodø (ultrasound), these being somewhat atypically long waiting times. The different forms of CT and MRI have waiting lists which are considerably longer, varying from 1-2 weeks and up to as much as 26 weeks at Nordland Hospital, Bodø, and 30 weeks in Vestfold (for general CT, as an example).

Our informants are nevertheless clear that these waiting lists are not appropriate for drawing general conclusions. First, these are not concerned with acute cases. According to our informants, those patients where a serious diagnosis is suspected are given higher priority. It is also the situation that hospitals always have sufficient capacity to receive urgent cases. As far as we have been able to ascertain, no statistics were able to show the extent to which diagnostic imaging is an actual bottleneck in patient treatment. Nevertheless, our informants were quite consequential in their statements that diagnostic imaging is a bottleneck for their patient groups.

The new government, a coalition of the Conservatives and the Progress Party has determined a 48-hour limit for cancer treatment. From referral, based on suspected cancer, to commencement of the diagnosis, no more than 48 hours should have elapsed. It is clear that diagnostic imaging will be an even more critical factor in the realisation of this ambition.

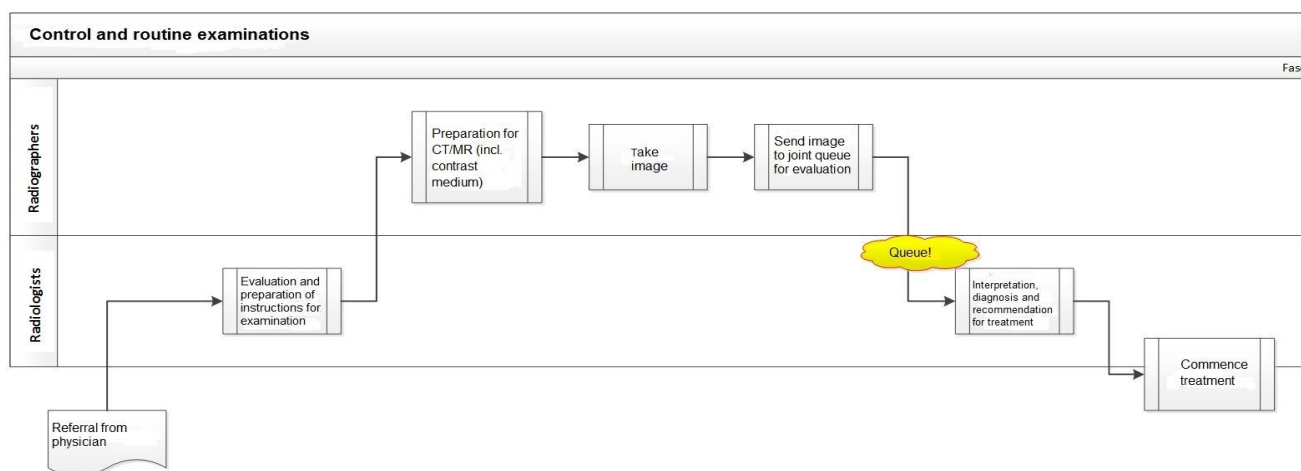


Figure 1. Control and routine examinations

Our informants point to interpretation/description of images as the most important bottleneck within traditional diagnostic imaging. The figure illustrates a typical flow for control and routine examination based on a department with 30 radiologists, 50 radiographers and around 100,000 patients per year.

The example in the figure shows a typical linear organisation of work tasks. NIFU's informants indicate that bottlenecks arise in the interpretation of images. They also suggest a number of remedies for these bottlenecks.

3.4 Three possible solutions to bottlenecks in diagnostic imaging

Based on the descriptions supplied by our informants within the health service, the authorities and interest organisations, there appears to be broad agreement that the use of diagnostic imaging, particularly the description of images, is a bottleneck within a number of patient treatments. Based on the information acquired from the literature, and through conversations with our informants, we have grouped methods for relieving bottlenecks in diagnostic imaging in three categories: increasing the capacity of radiologists, reducing demand, redistribution of work tasks. This can serve as a useful analytical concept for understanding the problem and for thinking systematically about possible remedies.

3.4.1 Increased radiologist capacity

It is possible to increase the number of radiologists, either at home or abroad. Nevertheless, this is a solution where results first become manifest a long time in the future. (It takes 12 years to train a qualified radiologist. See §1.2). No other Western country appears to have been successful in educating a sufficient number of radiologists to meet this problem.

It is also possible to increase the capacity of radiologists by importing specialists from abroad. However, Norway is not the only country reporting a shortage in the number of radiologists. This appears to be a phenomenon in all Western countries. Introducing measures which encourage radiologists to stay in their posts would have the same effect. It is also possible to outsource diagnostic image reports to external radiologists. All images are stored digitally and with current broadband technology it is not necessary for a radiologist carrying out diagnostics to be in the proximity of the patient. According to the radiologists with whom NIFU has had discussions, it is completely possible to separate interpretation of images from other activities linked to the patient. It was mentioned that in some institutions there is considerable contact between radiologists and radiographers. The possibility for the transfer of skills would disappear should interpretation functions

be outsourced. Since Norway is just one of several countries requiring skills in radiology, we should expect competition on capacity in this area. Hitherto, it does not appear that outsourcing has been an effective solution for Norwegian hospitals.

Measures designed to enable the radiologist to devote more time to image description, for example by reducing the number of administrative tasks, is also a method by which the radiologist's capacity can be expanded. Entrusting more training of assistant doctors to sonographers and radiographers will also make more time available.

3.4.2 *Regulate/restrict use of diagnostic imaging*

It is also possible to regulate or restrict the use of diagnostic imaging, alternatively to regulate use of the modalities. The Directorate of Health regularly provides guidelines which appear to establish norms for diagnostics and priorities. It can be thought that that this process can restrict use, or at least slow the growth of the information-heavy modalities. None of our informants has suggested this as a solution. Several considered that this could contain risks. All attached importance to strict priorities and that there are different treatment processes for acute cases and more routine diagnostic imaging.

In a scheme with self-opinionated and well-informed patients and general practitioners who do not have any particular incitement to limit the use of diagnostic imaging, it is hardly realistic to restrict the use of diagnostic imaging to any great degree without using extremely strong means.

3.4.3 *Task sharing – a reorganisation of responsibilities*

The third manner by which bottleneck may be relieved is the reorganisation of responsibilities. This can partly be concerned with changes within technology and logistics; it may also involve improved support functions for radiologists or a more efficient manner of transferring the radiologist's description to a final description (for example, from sound recording to text, etc.). By extending conventional X-rays alone to a combination of X-rays, CT and MRI, this has created a logistic challenge in many places. The hospitals we have spoken with plan some free time on the machines such that they can undertake investigations which were not scheduled but which they know will arise every day.

With a background in our examination of the literature, it is nevertheless a new distribution of responsibilities between the professions which appears to have the largest potential for solving these tasks.

4 Task sharing in practice

We have studied four different medical areas by visiting five different departments in four hospitals. In each of these locations we interviewed one or more co-workers. As explained in the Introduction, these departments were selected with the aim of illustrating processes and conditions associated with the theme of this report – bottlenecks and task sharing. At the four locations, we studied different examples of how these tasks have been organised and the type of task sharing which has been introduced. Table 2 provides a review of the categories of task sharing studied. Thereafter follows a summary of some of the main finds from our visits. Other separate findings are integrated into other parts of the report.

Table 2. Types of task sharing

Case no.	Medical field	Tasks	Modality	Position – title	Interviews
1	Cancer treatment	Indication of organs for radiation treatment ⁹		Radiation therapist ^a	2
2	Orthopaedic	Description of fractured bone	X-ray and ultrasound		3
3	Diagnostic imaging	Ultrasound investigation of upper abdomen	Ultrasound	Sonographer	4
4	Cardiology	Administration of contrast media, imaging and processing, placement of stents and balloons in arteries.	X-ray and ultrasound	Echo-cardiographer	1

a. Radiographer with post education in radiotherapy

The list is not a comprehensive review of all examples in Norway but is based on information obtained in interviews associated with this project.

4.1 Task sharing within diagnostic imaging

Our informants mentioned that a close association cutting across traditional professional boundaries was decisive for a successful result. For example, it was mentioned that within cardiology there were many factors which influenced which person undertook a specific task, how much experience that individual had, how many images had been studied, and where he or she was standing in the room. The importance of position in the room is something which was mentioned during one interview. We interpret this as stating that all who were present in the room are able to undertake most tasks, either alone or with instruction or support of a colleague close by. This suggests a high level of skills, long experience and considerable mutual confidence. In Case no. 3, we visited one locality and observed how radiographers and radiologists had organised a considerable degree of interaction, something they considered to be particularly important when a radiographer was to undertake new tasks. They also considered it to be very important that the radiographer was willing to ask for assistance, or to indicate when he or she was uncertain.

If radiographers are to take over more of the radiologist's tasks, then close cooperation with the radiologists is of prime importance. It would be unfortunate if radiographers had been used without having had this cooperation. A dialogue is needed in any case during the first year (Interview 4).

⁹ Determining limits and verification

4.2 Has the redistribution of responsibility been successful?

NIFU has not been in contact with patients in order to obtain their viewpoints, and we have not had access to quantifiable measurements on quality prior to, and subsequent to, the changes. Our analysis is based on interview data obtained from those who have been involved in task sharing, from interviews with patient organisations and associations, together with data from previous studies.

Everybody we have interviewed, and who had participated in the various measures taken, was pleased with the results and considered that the redistribution of responsibilities had contributed to relieving the radiologist's workload as well as patient flow. In Example 4 relating to cardiology, the gains were somewhat different. There was not a clear moderation of functions between the various professions – the gains were seen in that the whole team functioned in an optimally effective manner. Within cardiology, there is also good data on time-use, but without that this indicated the extent to which these improvements were directly related to task sharing. Several mentioned that it was difficult to get everybody to accept that radiographers should be given more responsibility (Examples 2, 3), but when the radiographers had gained more experience, the changes were accepted. Radiographers reported that it was stimulating to have the possibility to expand their knowledge and experience. Further training and education of the radiographers has provided them with several possibilities within the health service, but has also opened the door to other job opportunities. Several who we wished to interview had received offers of jobs with suppliers of equipment, and therefore did not wish to be interviewed. This suggests that the supplementary training and education of these radiographers – in this case sonographers – had made them particularly attractive in the labour market and that the value of their unique combination of practical experience and theoretical knowledge had been recognised.

Based on the interviews, a number of common characteristics following the redistribution of responsibility within diagnostic imaging can be recognised (Table 3).

Table 3. Features of the four examples of task sharing in diagnostic imaging

Ex. no.	Formal education / higher education	Planned practice training and supervised follow-up	Proximity to experts	Long experience as radiographer	Consultative working environment	Radiologist had worked abroad	Clearly defined field	Y/N decisions
1	X	X		X	X		X	X
2	X	X		X			X	X
3	X	X	X	X	X	X	X	X
4	X		X	X	X	X	X	

These characteristics emerged during our analysis of interview data. The informants were not asked directly about these types of characteristics, but to describe their current work procedures and experience with task sharing on a general basis. Since we have not asked directly about these types of characteristics, there may be certain aspects which have not emerged from the interviews. In spite of any possible weaknesses in the descriptions, we can point to some common features where the task sharing has been successful.

When we compare our findings of the redistribution of responsibility in several medical areas, and experiences with the process of change, there is little which distinguishes Norway from other countries (see Chap. 2.1). That which has been mentioned concerning Norway is that radiographers experience much more opposition from the radiologists. Those radiologists with whom we have spoken have expressed positive interest for relief of certain procedures, and many consider that it is advantageous if their routine work tasks are taken over by radiographers. At the same time, radiologists are concerned that diagnostic imaging is practiced in a defensible manner. It was also mentioned that it is

important that the overall picture of the patient is maintained following the redistribution of responsibilities. The radiologists consider that it is important to maintain an overview of the patient's case history and that there is continuity and good communication between the various specialist doctors involved. Any future measures directed towards a redistribution of responsibilities should take this into consideration. Consideration should also be taken of the fact that in the majority of cases there will be a need for a radiologist to set aside time for follow-up and supervision of radiologists who are undergoing training.

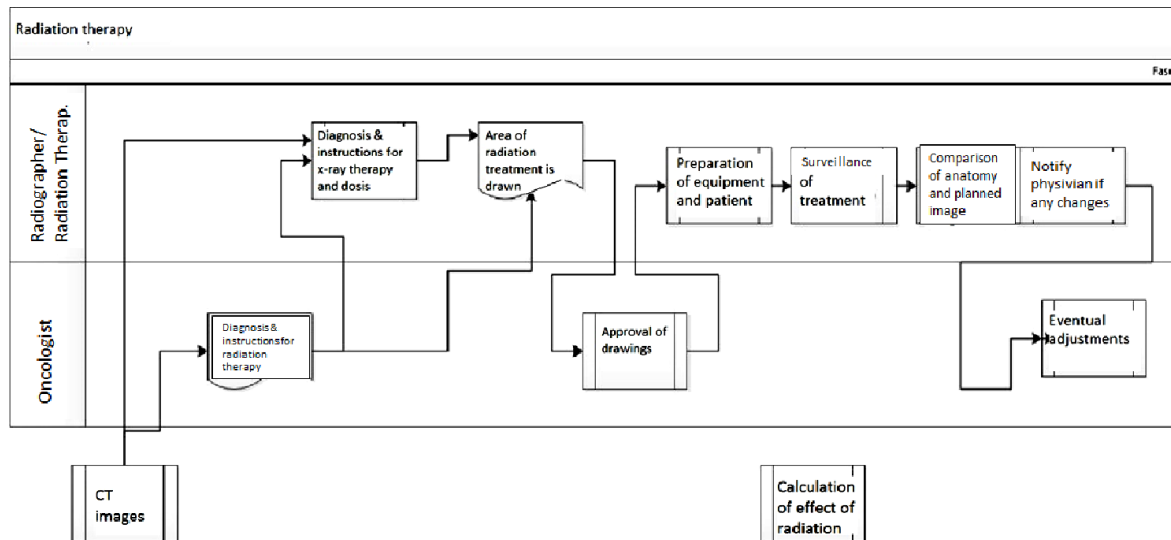


Figure 2. Comprehensive tasks in radiation treatment of cancer patients

Diagnostic analysis is used in many stages of treatment for cancer patients:

- Diagnostic analysis is used to diagnose cancer
- Diagnostic analysis is used in association with radiation therapy (See Figure 2)
- Diagnostic analysis is used in the follow-up and control.

In Figure 2, the various stages of typical radiation therapy are shown as for a large hospital and for certain types of cancer. The radiographer/radiation therapist has comprehensive tasks associated with radiation therapy, but there is also a significant interaction with the oncologist. NIFU's informants speak highly of the cancer treatment, and they are not concerned with which professionals carry out the various tasks, 'only that this is professionally defensible'. In the treatment of cancer patients it appears that the main problems are associated with logistics, organisation and information, more so than the use of diagnostic images.

We do not know whether the fact that those radiologists with whom we have spoken and who had worked abroad has affected the organisation of tasks which we observed. Since the distribution of responsibilities has come much further in many other countries than in Norway, it can be thought that that their experience with efficient radiographers in another role than that which they would normally have in Norway has made them more amenable to change.

In England, I worked more closely with the sonographers. We had ultrasound days where there were normally three sonographers and a radiologist who worked together. We divided

patient according to skills. As radiologist, I received the majority of acute cases while the sonographers were more involved with scheduled cases. There was close contact the whole time. They asked about various things, as I did. It was very enjoyable and I learnt a lot from this experience. They were very dedicated and clever. There was never any conflict (Interview 3).

Based on the interviews conducted by NIFU, we found that the following circumstances contributed to successful task sharing between radiologists and radiographers:

- Tasks which are to be shared are clearly defined
- Any decisions relating to the images are based on selection (Y/N), as, for example, with different screening programs
- The organisation is appropriate for sharing knowledge
- The working environment is developed as a more consultative environment
- Motivated radiographers with long experience are selected for post-graduate training and education
- All radiographers who are to be given new responsibilities participate in an approved EU post-graduate training and education program
- All radiographers are to be given new responsibilities are closely supervised by a radiologist in the initial period
- The need for archiving ultrasound videos should be considered
- Measures are followed up with an analysis of the number of errors, reduced workload of radiologists, in patients' experience and improved patient flow
- Radiologists should be encouraged to undertake more research, develop their professional field and to propose new application of technology instead of using time on routine tasks
- Changes which are carried out are supervised, and that the organisation reacts where a change does not function as intended.

5 Assumptions for Task Sharing

5.1 Circumstances fostering and hindering task sharing

Transfer of tasks between different professions within the health service has occurred ever since the health service was first instituted (Vigeland 2010). New needs have created demands for new skills, and new structures have made it expedient to transfer tasks between groups in the health service. Much task sharing has occurred simultaneous to a dynamic development where tasks are modified and transferred, and professional groups have taken on new roles in dialogue and understanding with other groups.

In compiling this report, we have particularly observed that there is great variation in the extent of task sharing, how this occurs, and who the decision-makers are. In the following, we describe the circumstances which we consider to be of major significance for task sharing within diagnostic imaging, and whether this has been successful. This chapter is based on information obtained from informants (see particularly Chapter 4), and other available information, including that from other countries (see, for example, Chapter 2.1).

5.1.1 *The consensus culture: Agreement on protocols, patient interests and quality of service*

The Norwegian health service is regulated according to a number of Acts which collectively contribute to reliability where the individual institution is accountable. Laws and regulations which govern the Norwegian health service include very few provisions which determine the specific functions to be carried out by a specific professional group. With few exceptions, it is up to the individual institution to organise its own activities. This is also a conscious policy of the health authorities through the Ministry of Health and Care Services, The Directorate of Health, and the Norwegian Board of Health Supervision. This form of control of the health service encourages a system with a strong consensus culture. This culture is concerned with the development of a common understanding among the various professions as to what comprises defensible practice with a given treatment of patients. Doctors have a central role in contributing to demands for defensible medical practice.

In preparing this report, we have observed that the consensus on specific tasks has arisen in different ways. Common to all is that if there is no consensus on what is defensible patient treatment, then a new sharing of responsibilities will not be sustainable over time.

In some situations, consensus arises out of necessity (see, for example, radiographers who take on tasks at night which are undertaken by radiologists during the day, Chapter 1.1.1). This frequently occurs in small institutions where there is a severe shortage of radiographers. In order to be able to meet patient requirements, radiographers and other professional groups have taken over tasks which have traditionally been carried out by radiologists. This division of tasks is frequently not the result of a specific policy, neither that of the administration nor the professions. The new – and possibly unconscious organisation of work tasks – gradually becomes the norm in some hospitals. Over time, these new procedures become developed and refined, and gradually operationalised as new protocols and routines. Even though new routines arose as the consequence of a shortage of radiologists, we have also seen that radiologists have subsequently regarded the new routines as objective and defensible.

Other types of consensus emerge as the result of a deliberate change in routines and work tasks. We have particularly observed this type of new consensus outside the traditional core area of diagnostic imaging. For example, within cancer treatment and heart procedures, oncologists and cardiologists have cooperated with radiotherapists, radiographers and other professions in determining new

organisation and new protocols where tasks, previously the responsibility of doctors, have been taken over by radiotherapists* and radiographers, although with the approval of doctors.

5.1.2 *Mutual respect for professionalism*

Establishing a new consensus on task sharing is a complicated procedure, and requires trust in order to be carried out in practice. One important conclusion of NIFU's observations and interviews is that task sharing is simplest to achieve when the professional authority and expertise of the various professions is not challenged to any great degree. By way of example, it is less problematic for cardiologists to surrender tasks associated with diagnostic imaging of the heart since cardiologists' expertise is in other areas.

In order to come to a situation enabling a satisfactory sharing of tasks it is necessary that mutual respect exists for the various professions' expertise and professional authority. In practice, this implies that groups which potentially are to take up new tasks (reporting radiographer, radiotherapists, and sonographers in our case) must have respect for the special skills inherent in that profession with which tasks are to be shared (radiologists in this case). In order to achieve optimal conditions for task sharing, both patience and the will to understand the other profession's situation are required.

5.1.3 *Work organisation*

The organisation of work concerning patient's treatment appears to be particularly significant regarding the development of task sharing. Two extremities stand out in particular. Network organisation encourages task sharing while linear organisation of tasks restrains such development. An additional factor which, based on our interviews, seems to work in cooperation with the work organisation concerns daily contact. Where daily contact is a characteristic of two professions, work emerges as being more team-organised and network-organised. However, daily contact is also a factor which encourages mutual respect (Chapter 5.1.2), resulting in objective distribution of tasks (Chapter 5.1.7).

Network organisation or team organisation involves two different professions working jointly in the treatment of a patient. In these situations, each profession is exposed to the strengths and weaknesses of the other. In practice, one will observe which tasks the individual profession is best suited to carrying out, and which stimulate team organisation. For example, time will be a critical factor for patients in an acute phase. It is then necessary that the different professions work simultaneously and in cooperation. Children are a special category. It is commonly accepted that the number of pictures (images) taken of children should be kept to a minimum. Exposure to the different forms of radiation and the practical fact that children are less disposed to keeping still for any length of time implies that image-taking shall be as efficient as possible. In order to achieve efficient diagnostic imaging, the skills of the various professionals must be considered: radiographers must be consulted on the most effective and considerate production while radiologists shall be quite clear about what types of image are absolutely necessary in order to achieve a good and adequate description.

Linear organisation, on the other hand, has a restraining effect on task sharing. A linear organisation of the work implies that tasks are carried out in sequence. In classic diagnostic imaging, the professions are less exposed to each other's skills.

5.1.4 *Task sharing is dependent upon the individual*

The interviews revealed that many considered that personal attributes affected the degree of task sharing. Simply, radiologists particularly desire to transfer tasks to radiographers upon whom they can rely. It is emphasised that it is important that the radiographer must have the ability to understand when the respective party does not possess the skills to solve the task and seeks assistance (from the radiologist). The responses suggest that systems are not sufficient so as to be able to control the skills of those who are to take over the tasks or routines and how these are to be carried out. It is worth

noting that Vigeland (2010) states this type of argument as construed so as to avoid a redistribution of tasks.

It is radiologists in particular who feel uncertain whether the quality of service to the patients is upheld with task sharing. Nevertheless, both the administration and radiographers seek routines in order to achieve satisfactory assumptions for transferring routines. Better systems for quality assurance of both tasks and staff are required, irrespective of which profession is to carry out the task.

5.1.5 Preparing for development of skills

A point of issue concerning task sharing within diagnostic imaging is the availability of a sufficiently large number of patients to provide the necessary practice for both radiologists and radiographers. Young radiologists in particular have expressed concern that they do not have access to a sufficient number of patients in order to acquire the necessary experience should radiographers take over many tasks. This is a justifiable concern to which consideration should be made in order that task sharing shall function satisfactorily.

Regarding radiographers, there is also a need to ensure that circumstances facilitate further training and education together with the possibility for continual updating such that new tasks are executed in a defensible manner.

5.1.6 Critical mass and diagonal task sharing

The size of the hospital is a factor which can have both stimulating and restrictive effects on task sharing in diagnostic imaging. Information from staff representatives of the radiographers suggests that in practice, most task sharing occurs within small units. This is related to the situation whereby the shortage of radiologists is greatest in small units throughout the country. We have seen that this shortage has necessitated radiographers (and other professional groups) taking over the tasks normally carried out by radiologists.

At the same time, the larger units will be of sufficient size to ensure an adequate patient basis such that the various professions will have their needs for practice and training accommodated. The circumstances should therefore be such that task sharing is also facilitated in the large units. At the same time it is frequently the case that the large units have relatively more radiologists than the small units (which are normally located in the rural areas). This has the opposite effect. When there are many radiologists, alternative organisational structures or task sharing are not put to the test.

One special observation which can be related to the size of organisation is that which we refer to as 'diagonal task sharing' (See Chapter 1.1.1). From the interviews, we have observed that radiographers, both with and without post-graduate education, have worked with specialist doctors outside the traditional radiological departments. In this cooperation, various forms of task sharing have developed which are not normal within the traditional radiological departments, nor within the same health institution. Radiographers have had the opportunity to carry out tasks outside the radiological departments which they do not have the opportunity of executing within these departments. We have frequently noticed this in the relatively large units.

5.1.7 Task sharing requires appropriate demarcation

Both the available literature and interviews with staff who undertake diagnostic imaging (see Chapter 4), as well as other interested parties, suggest that there is a need to demarcate task sharing along many dimensions in order that it shall succeed.

Modality. Diagnostic imaging is carried out using different types of technology ('modalities'). Interviews carried out by NIFU suggest that the threshold for changing task sharing is lowest for the two

traditional modalities: x-rays and ultrasound. This can be attributed to the two modalities being well established and producing relatively distinct images. CT and MR, on the other hand, can be used to produce extremely complex images with a high level of information, considerably beyond that which is normally required relative to the clinical problem. Radiologists have expressed scepticism concerning the interpretation of images being transferred to professionals who they do not consider as having sufficient education. Further, it is such that using ultrasound, image production and reporting occur simultaneously. It is then necessary to interpret the images at the same time as these are produced. During pregnancy, both midwives and doctors actively employ ultrasound. There is a development currently taking place which extends task sharing involving the use of ultrasound to new situations (see below).

Organ parts. In an extension of the discussion on the use of modalities, a demarcation can occur regarding the different human organs. It is particularly diagnostic images related to the upper part of the abdomen (using ultrasound) and to the extremities¹⁰ (using X-ray) which indicate new areas where it is possible to undertake task sharing. There is also reason to believe that future task sharing will occur as a result of diagnostic imaging focussing on specific parts of the organ. Further, it may be thought that a specialist in the interpretation of skeletal images of limbs can profit from a comparison of images of the same body part/organ performed with other modalities.

Medical conditions. Demarcation of specific organs is closely associated to the delimitation of special medical conditions. Within X-rays, it is particularly fractures which are seen to be an area where new task sharing could take place.

Diagnostic complexity. In situations where the diagnosis is relatively simple, circumstances are more favourable for new task sharing. If, for example, there is a question of determining whether a fracture exists, there is much to suggest that a reporting radiographer with long experience would be able to undertake a report in a defensible manner. Where there is mention of more complicated diagnoses, it will be more difficult for tasks to be transferred. It can be argued that the objective of a long specialist education is precisely to enable such complex diagnostics to be undertaken. One example illustrating this is that at Oslo University Hospital a large proportion of patients undergo complex diagnosis.

Our informants do not consider that radiographers can relieve doctors to a similar degree as with the interpretation of CT and MR since this requires skills which radiographers do not believe that they possess. '*A broad medical understanding is required in order to interpret CT or MR*' (Interview 4, radiographer).

A number of informants suggested that radiologists should be given more time to understand how CT, MR and PET and can be used efficiently. '*They should be given time to investigate purposes to which all this fantastic technology can be put*' (Interview 5). The hospitals with which NIFU has been in contact have shifts extending beyond normal working hours such that CT can be employed as and when required. In smaller hospitals, MR investigations are not usually undertaken outside normal working hours.

5.2 Protecting the interests of the parties

Many professions have an interest in diagnostic imaging. In the following, we consider some of the most important. Protecting these interests is an important assumption for efficient task sharing.

Patient interest. Diagnostic imaging is a key process in many different types of patient treatment, particularly those associated with cancer and various forms of acute and chronic conditions related to

¹⁰ Radiographers are now educated to interpret two main groups: extremities/peripheral – and central/axial skeleton.

joint and muscle disorders. For these patient groups, it is particularly important that diagnostic image services are readily available and are of high quality. At the same time, it must be emphasised that there is a fairly strong debate concerning the priority to be given to specific illnesses.

Authority interest. Norwegian authorities have an interest whereby the health service shall be efficient and of a high standard. In the organisation of the health service, including judicial legislation, the authorities have determined conditions for task sharing where the principle of defensibility forms the basis. Accordingly, a health authority can organise its activities within fairly broad boundaries. Only to a very limited extent are special tasks the sole domain of specific professions. The authorities also have the overall (often difficult) responsibility of determining the priority to be given to the various patient groups.

Profession interests. The various professions and/or work groups (and their organisations) have their legitimate professional interests which have to be protected. For radiographers there has been an increasing emphasis on academic qualifications with longer and more specialised education. At the same time, there has been a remarkable development in technology enabling radiographers to carry out far more advanced tasks than those which they currently undertake in their everyday duties. On the other hand, radiologists have a need to preserve their professional authority and integrity. Among other things, it is maintained that there is a need for a long and advanced clinical education in order to carry out complicated and complex diagnoses. Consequently, some expressed scepticism towards task sharing which they feared might undermine the quality of services.

Diagnostic imaging encompasses various illnesses and different types of patient treatment. There are distinctive features of cancer treatment and chronic illnesses, or other conditions, which place specific demands on the type of modality, skills, staff and organisation of tasks. It is not certain that any standard principles may be determined for the organisation of the work. On the contrary, our work may point in the direction of indicating a need for finding alternative solutions related to different forms of patient treatment.

6 Conclusions

Our conclusions and recommendations based on the work with this report can be summed up in the following points.

- **Diagnostic imaging is a bottleneck.** It is difficult to make a precise estimate of the significance of this bottleneck. Our informants are completely unanimous that diagnostic imaging is a bottleneck, and that there are some significant delays in certain diagnostic imaging techniques.¹¹ *We recommend* that statistics which are more precise be prepared relating to the demand and availability of different diagnostic imaging techniques. It has not been possible to generate such statistical information within the framework of this project. Nevertheless, the Norwegian Radiation Protection Authority or the Norwegian Directorate of Health can contribute in acquiring this data.
- **Task sharing provides the greatest potential for removing bottlenecks.** Experience from other countries suggests that it is particularly demanding to educate and train more radiologists in response to the shortage of radiologists, especially since it takes 12 years to educate and train a specialist radiologist.¹² Neither does restricting the demand for diagnostic imaging appear as a particularly realistic alternative. This has not been successful in other countries, and Norway does not rank particularly highly in patient treatment per 1000 inhabitants. *We recommend* that the groundwork be laid for objective task sharing within diagnostic imaging. We emphasise that patient safety, quality of treatment and the principle of defensibility shall always form the basis of diagnostic imaging. We have not been able to find any documents which indicate that the changes we have observed within diagnostic imaging thus far have resulted in any deterioration in the service. Further, we have found little research on this theme. It may be advisable to commence a controlled attempt to document and ensure that quality is upheld during changes in task sharing.
- **Preparation should be made for good task sharing.** Appropriate task sharing does not arise automatically. *We recommend* that preparations are made such that the consensus culture is respected and developed, that task sharing proceeds with respect for the various profession's distinctive characteristics and integrity, and that preparations are made for professional development, that tasks are organised such that the various professions solve tasks jointly and avail themselves of each other's qualities.

In the following we describe basic considerations required for good task sharing.

6.1 Working for a consensus and confidence building

In our work, we have observed how task sharing must be based on the defensibility principle and that mutual respect for each other's professionalism is an assumption in order to achieve good task sharing. We consider that it is possible to utilise the Norwegian consensus culture positively in order to build confidence and to achieve a more objective task sharing. Work should be done to develop a

¹¹ Waiting times give a very imprecise picture of the actual situation concerning diagnostic imaging (See Chapter 3.3). In particular, waiting time statistics state little about acute situations.

¹² Even though Norway has a better coverage concerning radiologists than is the case in most other countries (with the exception of Sweden), the demand for radiologists still exceeds the supply. As of today, there is relatively satisfactory coverage of radiographers, but the supply here is a potential future bottleneck.

consensus on what is professionally defensible but without that there is necessarily agreement on the specific division of tasks.

6.2 Professional overlap: Knowledge in ‘a common pot’

In this study we have observed that everything which creates a common organisation appears to have a stimulating effect on creation of new and objective task sharing. If one wishes to establish conditions for increased task sharing, the hospital administration can create joint professional arenas where different groups work together on the same patient treatment. Where overlapping situations arise, stimulating teamwork, our material indicates that this will result in a new organisation of work and new task sharing. Utilising other professions’ knowledge in training new colleagues will result in the establishment of a corresponding basis for new task sharing. If this knowledge is to be found in ‘a common pot’ where one may mutually draw on objective knowledge, this provides a basis for cooperation and task sharing.

As seen in Chapter 5.1.3, diagnostic imaging is most efficient when the skills of the respective professional groups are drawn upon. Radiographers can be consulted on the most effective and considerate production while radiologists can determine which images are strictly necessary in order to prepare a satisfactory and adequate report. Such cooperation and knowledge-sharing is an assumption for effective and good work. There is also much to suggest that the quality of diagnostic imaging services increases when the skills of all involved professions are drawn upon.

6.3 Preparing for professional energising of the entire diagnostic imaging field

Viewed from the outside, it can appear that the present situation is restrictive, for both radiologists and radiographers. Radiologists are subject to severe pressure of work: they are concerned with defending their unique professional skills, but simultaneously encounter limited opportunities to undertake development work, further education or research on account of the pressure of work. Should an alternative organisation of work tasks relieve radiologists such that they may undertake tasks which appear to enhance their professional skills, this may stimulate increased interest for developing constructive processes for task sharing.

For their part, radiographers have increased professional and academic ambitions and desire more challenging responsibilities. For radiographers, task sharing will result in more varied work practice. This in turn points towards further education and training for which a need is recognised, qualifying radiographers for new tasks.

References

- BR050601 (2011). *Rapport- Beskrivende radiografer - Skjelett radiologi – ARN/OUS*. Oslo 1. juni 2011. Ikke publisert rapport mottatt fra en prosjektleder på Rikshospitalet.
- Buskov L., Abild, A., Christensen, A., Holm, O., Hansen, C., Christensen, H. (2013) *Radiographers and trainee radiologists reporting accident radiographs: A comparative plain film-reading performance study*. *Clinical Radiology* 68:55-58
- (CoR) College of Radiographers & The Royal College of Radiologists (1999) *Team Working in clinical imaging*.
- Eraut, M. (1994) *Developing Professional Knowledge and Competence*. Falmer Press: London
- Forman, H.P., Larson, D.B., Kazweooni, E.A., Norbash, A., Javitt, M.C., Beauchamp, N.J. (2011) *Commentary: Masters of Radiology Panel Discussion – How do we maintain control over imaging?* *AJR* 201:128-132.
- Forsetlund, L., Vist, G. E., Dalsbø, T.K., Straumann, G.H., Underland, V., Norderhaug, I.N., Holte, H.H. (2013) *Effekter av oppgavedeling for noen utvalgte helsetjenester i sykehus. Rapport for Kunnskapscenteret nr 12 – 2013. Nasjonalt kunnskapscenter for helsetjenesten*
- Forsyth, L.J., Robertson, E.M. (2007) *Radiologists perceptions of radiographer role development in Scotland*. *Radiography* 13:51-55.
- Gibbs, V. (2013). *The long and winding road to achieving professional registration for sonographers*. *Radiography* 19:164-167.
- Gunderman, R.B. & Brown, B.P. (2012). *Excellence and Professionalism in Radiology*. *AJR* 200:W557-W559.
- Hoffmann, B. & Vikestad, K.G. (2013) *Accuracy of upper abdominal ultrasound examinations by sonographers in Norway*. *Radiography* 19:186-189.
- Kvale, S. (1996) *InterViews*. Sage Publications: Thousand Oaks
- Kuhlman, M., Meyer, M., Krupinski, A. (2012). *Direct Reporting of Results to Patients: The future of radiology*. *Acad.Radiol* 19:646-650.
- Lone, I., Thorsteinsen, T. I., Leiros, E. og Engelsen, S. (1995) «Røntgensykepleiere og radiografer», i Poppe, E. og Aakhus, T. (red.), *Medisinsk radiologi i Norge, Festskrift ved 100-års jubileet for oppdagelsen av røntgenstrålene*. Tano.
- Moran S., Taylor, J.K., Warren-Forward, H. (2013) *Assessment of the willingness of Australian radiographers in mammography to accept new responsibilities in role extension*. *Radiography* 19:130-136.
- Nixon, S. (2001) *Professionalism in Radiography*. *Radiography* 7:31-35
- Norsk radiologisk forening (2008) *Holdning til spredning av ultralyddiagnostikk. Uttalelsene fra Radiologforeningens ultralydvalg*.
www.radiologforeningen.no/img/wysiwyg/File/pdf/ULTRALYDRAPPORT2008-1.pdf
- Poppe, E. og Aakhus, T. (1995a), «Den internasjonale bakgrunn 1895-1920», i Poppe, E. og Aakhus, T. (red.), *Medisinsk radiologi i Norge, Festskrift ved 100-års jubileet for oppdagelsen av røntgenstrålene*. Tano.
- Poppe, E. og Aakhus, T. (1995b), «Trekking ved utviklingen i Norge» i Poppe, E. og Aakhus, T. (red.), *Medisinsk radiologi i Norge, Festskrift ved 100-års jubileet for oppdagelsen av røntgenstrålene*. Tano.

Price, R.C. & Masurier, S.B. (2007) Longitudinal changes in extended roles in radiography: A new perspective. *Radioography* 13:18-29.

RCR, Royal College of Radiologists (2012) Team working in clinical imaging.

Skjennald, A. og Tausjø, J. (1995) «Spesialistutdannelse» i Poppe, E. og Aakhus, T. (red.), *Medisinsk radiologi i Norge, Festskrift ved 100-års jubileet for oppdagelsen av røntgenstrålene*. Tano.

Statens Strålevern (2010) Radiologiske undersøkelser i Norge per 2008. StrålevernRapport 2010: 12.

Vigeland, E.(2010) Profesjongrensener i medisinsk bildediagnostikk: Tid for en ny arbeidsdeling? Masteroppgave Universitet i Oslo.

Appendix

Informants

Sykehus Innlandet – 1 radiologist, 4 radiographers (1 av radiographer is qualified as a sonographer)

Radium Hospital – 1 radiographer

Sykehuset Vestfold – 1 radiologist

Oslo University Hospital – 2 radiographers (separate interviews)

Organisations

Norwegian Cancer Society

Norwegian Directorate of Health

The Norwegian Radiological Society

The Norwegian Society of Radiographers