A Critical Evaluation of Decentralised Radiological Services in Norway – a rural case study

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Abstract

Background

Implementation of the Norwegian government’s Coordination Reform (2012) aims to decentralise health care services from centralised hospitals to the local communities. Radiological services in Norway are mainly organised in hospitals, because of the significant financial and human resource demands engendered by the need for advanced technological equipment, and specialised staff. Some selected conventional x-ray services have been decentralised into rural communities. The purpose of this case study was to evaluate different stakeholders’ perceptions of organizing decentralised radiological services in a rural area in Norway.

Methods

Following an extensive policy and literature review and a survey of GPs in the rural area being investigated two focus groups were conducted to obtain stakeholder’s evaluation of the radiological services in both hospital and rural contexts. The key emergent themes from the literature - decentralization, quality, professional roles, organisation and economic consequences – were discussed with each focus group. Thematic analysis was used for analyzing the primary data collected.

Results

Four main themes emerged from the focus groups: organisation, quality, funding of radiological services and cooperation between health care professions and health care levels. The quality of service was found to be inadequate in some areas because of the superficial level of training given to non-radiographic staff. It was found that the organisation of decentralised radiological services to rural areas is challenging because of the way health services are structured in Norway. This structural framework increases the need for effective cooperation and responsibility between health care professions and levels. There needs to be improved co-working by clearly defining roles and responsibilities.

Conclusions

The stakeholders agreed that decentralized radiological services is important. Quality of the service
could be improved and should be given priority. A key recommendation for the organisation of rural radiological service was the development of a satellite link with an acute hospital. Structural change to the financial system whereby money follows patients, might also facilitate more patient-centred services across healthcare levels. Improved mutual understanding between rural radiological services and hospital specialists and managers is important for a high quality and consistent radiological service to be delivered across Norway.

Introduction
At the recent Inaugural International Human Capital Conference in Malaysia in November 2018 it was highlighted that international organisations such as the ILO, OECD, EU, as well as national governments ‘All stress the importance of forecasting future skills needs to ensure that education and training systems are suitably aligned with labour market needs to avoid skills gaps, shortages and mismatches. Yet there is still confusion at the practical level as to what constitutes human capital and how best to develop the future and current workforce to meet evolving labour market needs in a period marked by increasing uncertainty and accompanied by profound restructuring [1]. One example of restructuring is the move towards decentralised health care which is now increasingly common worldwide supported by innovative technology and the need to ensure that the patient is at the centre of care [2]. Such changes require a concomitant investment in human, as well as physical, capital. Human capital has been defined as ‘the knowledge, skills and abilities possessed by individuals are components of an organization’s human capital’ [3]. Pfeffer (1998) [4]suggests it presents a perspective of employees as organizational investments or assets that, when properly deployed, contribute to an organization’s efficacy. Whilst Becker (1993) [5] argues that human capital theory in terms of the ROI from education (or training). In simple terms, Human Capital involves two elements: Capacity (having the correct numbers of staff) and Capability (having the correct skills mix in the workforce). The need to invest in human capital to cope with the ever increasing demands on healthcare services, particularly in the developed world, have been recognised for healthcare generally; doctors [6] of which radiologists are a key speciality and of which there is an international shortage, which has been recognised in Scotland, which faces similar demographic and geographical
challenges to Norway, through a global recruitment drive and investment in radiology training [7] and Norway [8] for nurses [3]. Nursing intellectual capital theory: operationalization and empirical validation of concepts [9] with the latter authors identifying two factors comprising human capital. The first ‘reflects nurses’ practical knowledge (speciality certification, professional experience, and unit tenure), and the second ‘represents theoretical knowledge that nurses acquire through formal learning activities (academic preparation and continuing education)’ However, they acknowledge a gap in their theoretical proposition as it does not encompass ‘the knowledge nurses acquire informally through collaboration with colleagues’ i.e. social capital, which may be challenging for health professionals working in isolated areas such as those studied here. Hoff, Sutcliffe and Younf (2016) [10] highlight the human capital challenges for the non-physician healthier force in the USA, during an era of considerable change in healthcare, including for Allied Health Professionals such as physiotherapists, occupational therapists and pharmacists [10]. Saxon et al. [11] of which radiographers, the focus of this study, are part of this wider workforce, To address this countries such as Scotland, nurses and AHPs, including radiographers, have developed advanced/extended roles [12], [13] [14], and/or assistant practitioner roles [15] to enable the radiologists and more advanced radiographers to focus on the more challenging diagnostic and therapeutic activities; a development which seems to have been resisted to in Norway [16].

In Norway there has been a recent growth in decentralised health care [17], which creates demands for human capital, both in terms of capacity and capability, with quality and staff/patient safety vital attributes of the latter. This increase is in part explained by the Coordination Reform (2012), creating a vision for the future organisation and delivery of health services in Norway. The aim of the Coordination Reform was to treat people closer to home, to decentralise specialised health services to a larger extent, and to shorten the length of patient hospitalisation [18]. During the implementation of this reform, a number of health care services moved from being hospital based to providing local based treatment, including some radiological services. Radiological services are still most frequently delivered in large city centre hospitals. It is widely accepted that there is a demographic trend worldwide towards an increasingly ageing population. This situation will require more complex health
care services and increase in health care costs. To reduce costs and make health care services more easily accessible there is a trend towards decentralising health care services. Challenges in the interaction between the different levels within the Norwegian healthcare system, for example, regarding different funding systems and uncoordinated computer systems, have been recognised in the coordination reform [18].

The population of several counties in Norway is dispersed over large areas. The decentralisation of medical services through an expansion of the scope of the primary health care sector may offer solutions to the current problems by enabling the delivery of health care services to rural areas at the point of patient need through the deployment and development of appropriate staff.

According to the Norwegian Directorate of Health [19], 216 municipalities are defined as rural. These municipalities are located at a distance of more than 50 km from a hospital with acute services. There are around twelve LMC in Norway, and seven similar centres are to be established.

To date international literature about decentralised radiological service is limited and there has been little advice and/or research globally to inform healthcare professionals about how to establish radiological services in rural health centres [20] this study attempts to fill this gap.

Where such decentralisation is reported it is in other countries with significant land masses with dispersed populations, such as Norway. For example a study from New Zealand about community based use of radiological services found that Chest x-rays were the most requested investigation [21]. Whilst an Australian study indicated the importance of training for rural non-radiographic x-ray operators as well as the need to participate in a radiographic network to get feedback on image quality and protocols. The authors stressed that a radiologist should interpret the images [22]. Other studies pinpoint the need for e-learning and management support [23] and the difficulties raised by transferring radiographic tasks to other non-radiographer professionals, such as physicians or nurses [24].

This study endeavours to address this gap by contributing to our understanding of the challenges posed by the change of implementing radiological services at a local level, based on the experience and perceptions of stakeholders and the consequent findings will be of importance for decision
makers at the central government level (macro level), managers in rural areas (meso level) and in hospitals as well as staff and patients (micro level).

This part of the study addressed the following research questions;

RQ1 How do stakeholders evaluate the organizing of decentralised radiological services in a rural area?

RQ2 What are stakeholders’ opinion of the current functioning of the services and need for future challenges?

Organisation of decentralised health care

Challenges in the interaction between the different levels within the Norwegian healthcare system have been recognised for many decades [18]. Decentralisation builds on the idea that smaller organisations are more responsive and accountable regarding health services to the public than larger organisations[25]. Saltman and Bankauskaite [26] define decentralisation in terms of three key functional dimensions: political, administrative and fiscal. Political decentralisation has traditionally been referred to shifting policy making responsibility from a centralised system to several local ones [27]. Administrative decentralisation is about developing an effective service, building an infrastructure and developing a workforce policy. The size and composition of the workforce is critical for a high quality service [28], as alluded in our earlier discussion of human capital. Rondinelli [29] also defines decentralisation as a four-part framework of devolution, decentralising, delegation and privatisation.

Primary/local health care in Norway is organised in the 434 municipalities. Each local municipality is responsible for the delivery of a large number of services, which are part of primary health care, for example home treatment, nursing homes, social care and part of mental health care.

In Norway, decentralised radiological services are organised in different ways; some are decentralised and funded by a regional hospital, while others have been established by a municipality from which they also receive funding. These differences in organising depend on what each municipality’s own local government decides. There is a scarcity of research as to the effectiveness of implementation, their organisational structure and effectiveness, and stakeholder satisfaction in implementation of
decentralised radiological services.

Differences in use rates of radiology services between urban and rural areas in Norway has been observed [30], but these differences were not quantified, nor has there been any measure of quality. The trend indicated that rates per thousand of examinations were higher in urban areas compared with rural areas.

The study context

This study took place in a rural area in Norway; at the local medical centre (LMC), the regional hospital (RH) and at local GP practices in Hallingdal.

The local LMC, was established in 1979 and therefore had many years of relevant experience in the provision of health care service in a rural area. The radiological service was established in 2002, with one conventional x-ray machine for skeletal and lung imaging. The LMC serves six municipalities in the area with approximately 20,000 inhabitants. The LMC is a decentralised community hospital with 14 beds, located 170 km away from the host hospital and offers acute and emergency services, several kinds of telemedicine supported by specialist consultants, midwifery services, dialysis, and palliative cancer care, the LMC also offers radiological services five days a week (Monday to Friday) between 8.00 a.m. and 4.00 p.m.

In the district surrounding the LMC 26 GP’s are practising. The number of GPs in this region is sufficient compared to other regions in Norway [31].

Method

The design of the study was explorative and draws on a single -embedded case study [32, 33, 34]. The study has a qualitative priority because the primary aim is to evaluate the radiological services by exploring the perceptions, opinions, challenges and experiences of stakeholders working in, and using, decentralised radiological services. A convergent design has been used, to better understand the research problem.

Participants

Data collection was organised in two focus groups to gain in-depth knowledge and experiences from stakeholders working with decentralised radiological services in the rural area and in the regional
hospital. The groups were composed with stakeholders from different parts of the service, workers in different roles, managers from different units and GPs, trying to get a broad understanding. After inviting key people, two focus groups were conducted with; 1) staff from the LMC (the radiographer, the senior physician) and municipality leaders (two senior physicians, two managers responsible for health care) 2) staff at the hospital (the coordination leader, the head of the radiology services, one radiologist and the IT specialist).

After a standard introduction the moderator started each focus group by stating that there were no right or wrong answers and that all experiences or opinions they shared would be valuable for the study.

Data collection

A semi-structured guide, developed by the lead author based on an earlier questionnaire amongst GPs in the Hallingdal region was used to maintain the focus on the research questions and the participant’s experiences on benefits, disadvantages, drivers or hinders to decentralised health care was asked. Quality in service, organisation of the service, funding and the professional role of in decentralised health care were also discussed. The choice of a semi-structured guide enabled the participants to share their experience and views [35]. The focus groups were conducted over a 2 month period at the local LMC and in the regional hospital, moderated and supported by the first two authors. The focus groups were recorded and lasted about 40 minutes. A report from the focus group was provided and sent to the participants for comments.

The Norwegian Centre for Research Data approved the handling and storage of personal information in this study. The Norwegian Centre for Research Data considered approval of this study by the Ethical Committee to be unnecessary.

Data analysis

Qualitative data from the focus groups were analysed using qualitative thematic analysis [36, 37].

This thematic analysis used four stages as can be seen in Table 1 below, where the first stage was familiarising with data. The data from focus groups was transcribed shortly after they took place and then reading and re-reading of the transcribed material was undertaken and initial ideas noted. The
second stage was to highlight relevant material and define descriptive codes. The third stage of analysing the data was clustering descriptive codes and interprets the meaning of them. Stage four was to define and name themes.

Table 1: Stages in thematic analysis.

Results
Five themes emerged from the thematic analysis: organisation; safety and roles; quality; economic evidence; and cooperation. Each will be discussed below. In addition there was support for the principle of decentralised services, which is discussed next.

Decentralisation
Participants in the two focus groups were satisfied with the x-ray service at the LMC, and agreed on the need for a decentralised radiological service given the long distance involved in travelling to a hospital (a drive of about 3 to 4 hours). One GP said:

“The municipality managers and the GPs want a good health care service, a local service....”

Political policies around decentralisation were highlighted, such as the Coordination Reform, and in particular focused on patients’ rights to equality in health services that should not depend on whether patients live in a city or in rural areas. A hospital doctor stated:

They (the patients) have the right to exactly the same health care as someone who lives in a central area, so then it’s not really about money, we have a duty that we must fulfil, and this is what we must try to achieve.

Organisation
The health care and the radiological service was organised as a three-part service with: 1) x-ray facilities at the regional hospital, 2) x-ray facilities at the LMC, and 3) x-ray facilities at the GP’s surgery or at the emergency unit, placed within the LMC.

All the participants agreed that they were very satisfied with this threefold organisational model and described it as unique and special. One manager said:

“I think that as a region we are a bit special, given that every GP surgery has x-ray equipment; that is not common in Norway.....
Another manager remarked that:

“We have unique arrangements of x-ray service in our region”.

**Safety and Roles**

One of the solutions, which is challenging for the “model” of organising the radiological services in the studied area is legalisation regarding radiation equipment and protection. Norwegian legislation distinguishes between installed fixed x-ray equipment and simpler x-ray equipment. When the GPs take X-rays and interpret the images themselves in certain situations a second opinion may be required to make an accurate diagnosis for the patient. The focus group participants described technical limitations in their communication with the hospital. The images were sent by e-mail, or smartphone, and image quality was therefore often reduced for this reason. In particular, it was noted that the orthopaedic surgeon was unable to interpret inferior quality images prior to their transfer to the hospital and:

A head physician said:

“...*Often the orthopaedic specialist does not draw a conclusion based on the images taken by GPs*”.

To solve this problem the GPs participating in the focus group wanted a system that might allow digital images to be sent directly to the hospital imaging system for second opinion. However, this could potentially create further concerns regarding data security, as appropriate digital security protocols would require to be observed including encryption and password protected. Whilst, still a relatively low risk recent research, conducted since this study’s fieldwork, by Ben Gurion University in Israel [38] highlights the potential risk that radiological equipment, as part of the wider Internet of Things (IoT) could be vulnerable to corruption by cyber criminals or terrorists. This suggests a further training need for all staff involved in the use of radiological equipment and materials on top of what is already recommended by the IAEA (2015) [39].

**Quality**

The participants volunteered points related to the quality of the service, without the moderator’s intervention, thus suggesting its importance as can be seen by participants agreeing that they were offering a high quality health service. A municipality manager said:
“High quality health care services that make our region a good place to live in and good for tourists too”.

Nevertheless, three topics emerged regarding quality: radiation protection, training of staff at GP surgeries about positioning and technical x-ray issues, and resources. Despite the view that they were offering a high quality service, GPs also admitted that image quality could sometimes be better. The mobile x-ray equipment at the GP surgeries was limited and inappropriate for the examination of, for example, hips and spine. An experienced physician reported that:

“We have seen that that the images may not be good enough as we have noted in feedback from the orthopaedic surgeon”.

The participants from the hospital were clear about the need for high quality of the images taken by GPs to save patients from unnecessarily long trips to the hospital and possible inappropriate treatment. The quality of images sent from the GPs surgeries, was of therefore a concern. A hospital physician said:

“The principle is that it is not a radiographer taking the images up there (in the rural area), these people are basically amateurs and the radiologists have been rather concerned about the quality of the images and the projections”.

They stated that training of staff in the GP’s surgery is important and a discussion of training needs focused on positioning, technical aspects and radiation protection. The understanding of the radiographic principle ALARA (As Low as Reasonably Achievable) seems, alarmingly, not to be known by staff working in GP surgeries, and is clearly an example of a human capital capability need that requires urgent attention.

Economic impact
The focus group participants stated and agreed that decentralised radiological services save society a lot of money. Saving patients long travelling distances and ambulance capacity are expected to save money, but also travelling time for patients and relatives [40], including for tourists who would not want to be separated from their families at their time of need and it provides reassurance that Norway has accessible health facilities for winter sports enthusiasts. This economic saving was
emphasised by a physicist:

“For society—and the health economy we win on this. Also for our ambulance capacity having a local x-ray service means that ambulances can stay in region. An ambulance trip to the hospital costs about £2,000. It is expected to save about 2,000–2,500 ambulance trips by having x-rays in the GPs surgeries”.

The total saving for society will based on this quote be at minimum £ 4 000 000 each year. Thus investment in human capital can bring socio-economic returns.

Cooperation

A main theme that emerged was cooperation between the hospital and GPs. The participants raised the matter of importance of the need for good cooperation with the hospital to provide the best possible services for patients. The participants experienced very good cooperation between the Hospital and the GPs in the region. Indeed one of the district medical officers in the region highlighted:

“In our experience the hospital is genuinely concerned with good cooperation in our district so making a good decentralised healthcare is a common goal”.

However, participants in the hospital Focus group raised concerns about the distribution of responsibility between the hospital service and the GP imaging service, and they were clear about the fact that the hospital was not involved, and should not be involved, in GPs’ imaging practice. A head of IT services said:

“It is quite clear that it’s the primary health service that takes the image and is responsible for the patient until the patient is referred. It’s only when the orthopaedic surgeon says “you need to refer the patient” that the hospital assumes responsibility, and; until that point it’s the primary health service’s responsibility”.

The hospital participants were also sceptical about the principle of the current practice where GPs can obtain x-ray equipment. Despite this however, the hospital wanted to improve the quality of the GP imaging service by developing a system where the hospital IT system could receive images and orthopaedic surgeons could access the images and provide a second opinion. The head of medical
services at the regional hospital said:

“The cooperation could consist of the images being sent to us (the hospital) by local doctors. We could consider them before patients are treated. Otherwise local doctors take the images and deal with them (the images) themselves”.

To summarise the findings from the focus groups, the participants highlighted the need for decentralised radiological services. Particularly, as they felt this service was beneficial to the patients and saved society a lot of money, particularly as far as the ambulance service was concerned, and also that the travelling time for patients was reduced.

Participants from the district were very satisfied with the existing three-part organisation with a radiological service being provided in GP surgeries, at the emergency unit in the LMC and at the hospital. In contrast, participants from the hospital were worried about the quality of the images and the radiologic competence of staff at the GP surgeries. They would like to establish a new service for the GPs with the possibility of sending x-rays to the hospital IT systems for a second opinion.

GP’s themselves acknowledged that image quality was sometimes poor and a lack of radiological competence in the GP surgeries since GPs, nurses or even at times a medical secretary carried out the radiological imaging, which would be highly unusual in other developed countries’ health systems.

Discussion

As this research has shown; decentralized rural radiological services face several challenges regarding quality, organisation, funding and cooperation. The findings showed in Figure 1 will be discussed for each area. The differences in size between different parts in the model, indicate that quality is the most important dimension, so organisation, and then cooperation and funding.

Figure 1: Key findings, interaction, relative weighting implications for decentralised health care and recommendation.

Quality in decentralized radiological services

As described in an earlier study by Pavoloni and Vicarelli [41], one of the benefits of decentralisation is that this brings the health care services closer to where people live and is confirmed in this study.
Quality can be defined by factors such as efficiency of services, safety, the possibility of user interaction, coordinated services, the efficient use of resources, availability of services and their equal distribution [42]. This is a challenge in rural areas. The quality indicators at stake in this study were especially related to no radiography staff at the GPs offices as well unsafe use of X-rays. Hana and Rudebeck [43] states that the professionals working in rural areas play an essential role for quality of health care services when these services are decentralised. Participants in the focus groups confirmed the need for experienced, dedicated high-quality staff, and reported a high level of satisfaction with the radiographer working at the LMC, however they could only provide limited coverage of the area and time. Overall there were limitation in human capital, both in terms of capacity and capability. To address this gap dedicated and competent staff are essential in a decentralised health service, and the competence of administrative staff and those in leadership positions in primary care are also of importance for the quality of health services in rural areas. This is in line with studies from Australia and New Zealand [21, 22]. The people working at the GPs offices (physician, nurse and secretaries) as well as at the LMC and RH were all very committed to deliver high quality services, however that does not mean they have radiographic competence. The issues mentioned above may lead to discussions amongst professionals about skills and responsibility. Different professions may wish to protect their own discipline, without reflecting on possible consequences for patients. This inter-disciplinary rivalry presents a challenge for professional identity, for example image quality, radiation protection and standards are an inextricable part of the radiographer’s professional role, and in addition to the radiologists’ role in diagnosis and treatment. In contrast, the GP’s role is to diagnose and treat, and they perceived image quality and radiation dose as relatively minor concerns [44]. There is therefore an urgent need for continuing professional education and a closer connection with a radiological environment for both radiographers and other staff who perform x-ray imaging in rural areas, a point made also by Smith & Jones [44]. Smaller operating units will probably offer poorer quality than larger ones, partly because qualified staff in all disciplines is more difficult to recruit and retain. Health care services in rural areas are made up of small organisations, are distributed across extensive areas, lack qualified staff and a large
range of tasks have to be performed by a limited number of staff [43]. This is also the case in the studied region, where one radiographer runs the radiological service at the LMC and non-radiographic staff takes x-rays in the GPs’ surgeries. Interpretation of x-rays is undertaken by GPs, in many cases without consulting a specialist, which may result in subtle nuances in images not being picked up by generalists leading to misdiagnosis.

Fredriksson & Winblad [2] found in their study that a decentralised model for health care services results in inconsistency in rules and regulations. In this study it was found that there is a lack of clear and consistent X-ray procedures in GP surgeries, and decision-making based on X-rays or clinical examinations differed between GPs, depending on their experience, which was also found by another study identifying GP-related factors such as experience, as an important factor for rural practices [45]. Indeed in the region studies there were differences in the working experience amongst GPs which influenced their refferal practice to specialised health care; experienced GPs reffered less than not experienced GPs. Participants in the focus groups confirmed the need for experienced, dedicated high-quality staff, and reported a high level of satisfaction with the sole radiographer working at the local medical centre.

When discussing quality and staff competence, radiation protection also is an issue. One of the provisions of the Regulations on Radiation Protection is the presence of a responsible doctor. The regulations state that x-ray and MRI machines have to be operated by radiographers or a doctor with a relevant specialty [46]. Personnel using x-ray equipment should undertake training in radiation protection and use of radiation related to each working tasks every year. Clearly, this is not the case in the GP practices.

**Organisation of decentralized radiological services**

Saltman & Bankauskaite [26] have identified different models for organising decentralised health care. As previously mentioned the rural radiological service in the studied district is three-fold organized. However, these three layers of provision of radiological service found in the Hallingdal area
have different ‘owners’. A consequence of these different health care levels and ownership is that decision-making processes in these organisations are not integrated. The radiological service at the local medical centre is a satellite from the regional hospital, and decisions follow the hospital’s protocols. Whereas decisions for the X-ray service in GPs surgeries is taken by each GP in collaboration with the health system in each municipality. For the third service, in the acute unit, decisions are taken by the service itself in collaboration with municipality coordination. This is complex and may lead to local systems or “personal decisions” made on a more ad hoc basis, rather than a coherent service. Consequently, there may be a risk that health care services have different service provision and different standards of service in different areas.

With the current organisation, there appears to be an overlap in radiological services in this region, and there is probably potential for improvement in the organisation, which would result in a more cost-effective service, possibly of higher quality.

**Cooperation**

The way health care services are organised in Norway seems to hinder the efficient organisation of decentralised health care services. To provide high quality health care services to patients in all situations, the cooperation between the health care levels, primary health care and specialised health care, must be brought up to a higher standard more than is currently the case. The coordination reform [18] aimed to reduce these problems, and health care managers are working to reorganise the services by improving and increasing cooperation between levels.

Regarding the Cooperation reform [18] there is a need for cooperation between the levels in health care, with the aim of providing better health care for the patients. Participants in focus group one felt that the cooperation reform had contributed to improved cooperation between the rural area and the hospital. The reform had also improved the hospital’s understanding of the rural area’s needs. Because of the systematic cooperation, the hospital’s thinking and understanding of needs in the rural area was increased, and has already resulted in an expansion of the radiological services and the opportunity to receive a second opinion about images. This is a positive result about the reform and will be monitored once the new equipment and services are all in place.
Whilst acknowledging that stakeholders participating in the study agree that decentralised radiological services in the region are necessary and indeed are a requirement by politicians, professions and citizens, it is the view of the authors based on this study that services could be delivered more efficiently and effectively. Furthermore, a Swedish study found that decentralising health services can lead to local variation or inequality in services. Moreover there is a potential conflict between central and local decision-making [2]. Local variation can also Organisational culture emerges from that which is shared between colleagues in an organisation, including shared beliefs, attitudes, values, and norms of behavior [47]. Results from this study show that managers are taking the cooperation issue seriously, but not all problems have been resolved, there are still certain problems like common IT systems and procedures. Ferlie and Shortell [48] state that the lack of integrated IT systems can inhibit a high quality health care system. Although Hillestad, et al [49] are of the opinion that IT systems have potential for savings in the health care system; however they have to be fit for purpose. Technological development has the potential to be better utilized; digital imaging and tele-radiology have fundamentally changed radiology inasmuch as radiological images can now be sent electronically from a remote location to a radiologist in another location for interpretation or consultation[50]. Therefore, common IT platforms have the potential to facilitate knowledge sharing and ultimately improving quality. However, as noted earlier such developments bring with them data protection and security issues.

Funding

According to Saltman and Bankauskaite [26] decentralisation may lead to lower costs, since lower planning and administration costs are closely related to political decentralisation. Local politicians can have greater influence on how to use money in their own area. There is however a lack of consensus regarding the benefits of economic decentralisation. Dilemmas such as how to use taxes payment [51] and disagreement about policy for financial grants from the central government to local level governments are some of the issues still to be resolved.

Duplication of services in decentralised health care as is found in this study may make these services more expensive than central government controlled services. Results from this study indicate that the
region studied has the potential to achieve a more economically efficient radiological service, due to the current organisation being three-part and, in some areas, overlapping. A key issue is the balance between effectiveness and efficiency.

**Limitations of the study**

The current study is based on a single case study aimed to obtain and understand stakeholder experiences and perspectives of one decentralized radiological service in a rural area of Norway, which had developed organically prior to the recent reforms. Nevertheless, it provided a useful test bed to investigate the benefits and limitations of decentralised radiological services. Since stakeholders’ experiences were compared from a limited sample from one area, certain limitations should be expected. A different methodology could have been adopted for this study, for example an ethnographic study or comparative study comparing different rural areas either as multiple case studies or a questionnaire survey including more participants. Other approaches may have provided different perspectives. The study was conducted at one LMC, this does not give the study the opportunity to extend generalised findings to other LMC or radiological departments or radiographers, but it does provide some insights for key stakeholders to consider. Despite this limitations the study assumes importance given the lack of publications on decentralised radiological services. It will augment our understanding of the challenges posed by the change in radiological services at a local level, based on experience from stakeholders using such services in the Hallingdal region in Norway.

**Implications for practice**

When organising decentralised radiological service, organisation, quality, cooperation and funding are important elements. *Quality:* The study has revealed significant human capital deficits given that the radiological services in the GP surgeries and in the acute unit at the LMC need to improve the quality of x-ray imaging and the interpretation of images. Since there is non- radiographic staff taking x-rays in the GP surgeries, this study concludes that training and knowledge transferring in imaging and radiation protection is needed for non-radiographic staff including GPs. *Organisation:* The three-fold
overlapping structure could be more effective by merging the radiological service at the LMC with the emergency x-ray unit in the same building. Imaging at the GP surgeries can also be reduced by extended opening hours at the LMC. The radiological service at the LMC complies with safety regulations and is well run, with provision for high-level competence in radiological imaging and support from the hospital, including radiologists interpreting the images. Cooperation: Results from this study indicate a lack of cooperation between professions and between the specialised and primary care levels. There are concerns about differences in thinking between “the hospital” (fragmented thinking) and “district medicine” (holistic thinking). The study also indicates that responsibility between levels has to be clear so patients are not passed back and forth. Currently professionals in the hospital are not taking full responsibility for quality in the rural area. This is an obstacle to a high quality radiological service to patients in the rural area. Funding: Findings in this study indicate that funding challenges between the specialist and the primary health services remain unresolved. The health care funding system in Norway where hospitals are funded from the government level, and community health care from every local municipality, seems to hinder equal health services.

Further research

This study may be used as the basis for further research into health care services in rural areas, in particular the decentralisation of services, both in Norway and in other countries with significant rural areas and populations. For decentralising specialist health care, such as radiological service, there still seem to be hindrances, such as funding and limited cooperation, to an effective high-quality service. Future research topics could be to identify and explore these hindrances and to identify ways of overcoming them. The safety, data protection and security risks associated with radiological services make it a high priority for further research at national and international levels.

Conclusion

The organisation of the service in this area is unique given that it has a three-fold structure including 1) a decentralised radiological service available at the LMC administrated by the hospital; 2) at the
acute unit located at the LMC administered by the local municipality; 3) at the GP surgeries. This three-fold organisation, including imaging at the GP surgeries, has challenged the national health care system, whereas radiological services are generally organised in hospitals and not in the community health service. The matter of responsibility for radiological services is a challenge as the services overlap. Thus one of the conclusions of this study is recognition of the fact that this service would benefit from more efficient organisation and the service could be more cost effective. The results of this study indicate that imaging at GP surgeries in the case of minor urgent injuries is a good thing for patient convenience. However, the increased use of telemedicine support from a hospital, would improve efficiency and quality of care. The author is pleased to note that progress is already being made towards this recommendation as evidenced by the installation of a CT scanner and extended opening hours.

List Of Abbreviations

GP – General practitioner

LMC – Local Medical Centre

Declarations

Ethics approval and consent to participate

Ethics approval was not applicable in this study. The Norwegian Social Science Data Service approved the treatment of personal information – project reference 38617. The hospital administrative heads granted the research, by permitting employers to participate. All participants gave a written consent to participate in the study.

Consent for publication

Not applicable

Availability of data and material

The datasets generated and analysed during the current study are not publicly available due to participant anonymity issues but are available from the corresponding author on reasonable request.

Competing interests
The authors declare that they have no competing interests

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**Authors' contributions**

All authors participated in the planning of this study. All authors were involved in the analysis of data, revision and approval of the final manuscript.

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Table
Due to technical limitations the table could not be inserted here. It can be found in the supplemental files.

Figures

Figure 1

Key findings, interaction, relative weighting implications for decentralised health care and recommendation.