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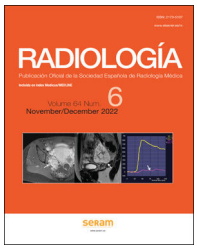

UPDATE IN RADIOLOGY

Teleradiology: good practice guide

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Abstract Teleradiology is the electronic transmission of radiological images from one location to another with the main purpose of interpreting or consulting a diagnosis and must be subject to codes of conduct agreed upon by professional societies. The content of fourteen teleradiology best practice guidelines is analyzed. Their guiding principles are: the best interest and benefit of the patient, quality and safety standards homologous to the local radiology service, and use as a complement and support of the same. As legal obligations: guaranteeing rights by applying the principle of the patient's country of origin, establishing requirements in international teleradiology and civil liability insurance. Regarding the radiological process: integration with the local service process, guaranteeing the quality of images and reports, access to previous studies and reports and complying with the principles of radioprotection. Regarding professional requirements: compliance with the required registrations, licenses and qualifications, training and qualification of the radiologist and technician, prevention of fraudulent practices, respect for labor standards and remuneration of the radiologist. Subcontracting must be justified, managing the risk of commoditization. Compliance with the system's technical standards.

PALABRAS CLAVE
Telerradiología;
Directrices;
Prácticas profesionales;
Cuestiones normativas;
Evaluación de calidad;

Telerradiologia: guía de buenas prácticas

Resumen La Telerradiología es la trasmisión electrónica de imágenes radiológicas de una localización a otra con el propósito principal de interpretar o consultar un diagnóstico y debe estar sujeta a códigos de conducta consensuados por sociedades profesionales. Se analiza el contenido de catorce guías de buenas prácticas de telerradiologia. Sus principios rectores son: el mejor interés y beneficio del paciente, estándares de calidad y seguridad homologables al servicio de radiología local y, utilización como complemento y apoyo del mismo. Como obligaciones legales: garantizar los derechos aplicando el principio de país de origen del paciente,

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Estándares de referencia;
Servicios externalizados;
Comoditización

establecer requisitos en telerradiologia internacional y seguro de responsabilidad civil. Con respecto al proceso radiológico: integración con el proceso del servicio local, garantizar la calidad de imágenes e informes, el acceso a los estudios e informes previos y cumplir los principios de radioprotección. En relación a los requisitos profesionales: cumplir con los registros, licencias y cualificaciones exigidas, formación y capacitación del radiólogo y técnico, prevención de prácticas fraudulentas, respeto a las normas laborales y remuneración del radiólogo. La subcontratación debe estar justificada, gestionando el riesgo de comoditización. Cumplimiento de estándares técnicos del sistema.

Introduction

Since the beginning of the 21st century, radiology has undergone extraordinary advances and expansion thanks to digital radiology, the networking of radiological processes, and teleradiology. Over the last three decades, teleradiology has been brought into general use, and this has led to major technological, professional, economic, organisational, cultural, ethical and legal challenges.

Traditionally, the development of teleradiology has been focused on diagnostic image reporting and the use of information and communication technologies (ICT). However, the task of the radiologist is not simply to generate reports or give their specialised interpretation of medical images. Rather, their role is to solve problems for referring clinicians by providing them with relevant diagnostic information, helping them make clinical decisions, and reducing the level of uncertainty. This is achieved through the interaction of technological, process and professional aspects, all focused on the benefit to, and best interest of, the patient. Good practice guidelines[1] should provide directives on these aspects, determine the fundamental principles of the activity, establish procedures based on ethical and legal norms, and define standards and indicators of quality and safety (Fig. 1).

The aims of this article are to review and analyse the concept of teleradiology developed by radiology societies and public law corporations responsible for healthcare management, and to analyse the regulatory framework in Spain (by consulting legislation published in the BOE [Official State Gazette] and CENDOJ [Judicial Documentation Centre of the General Council of the Judiciary]) and in the European Union (available in the EUR-Lex databases).

Teleradiology: general aspects

Teleradiology: an evolving concept

Over the last three decades, the concept and evolution of teleradiology has been shaped by technological advances, market forces and guidelines issued by radiology societies and health institutions.[1–14] Table 1 lists the bodies that have published good practice guides.

- *Formal conceptual viewpoint*. Teleradiology is a telemedicine service, involving the electronic transmission of radiological images from one location to another for the primary purpose of interpretation or diagnostic consultation.[15,16]
- *Instrumental viewpoint*. With the universalisation of digital radiology, picture archiving and communication systems (PACS) and the use of IT, 'traditional' radiology is indistinguishable from teleradiology. The quality and safety requirements of both the digital image and the imaging report are the same, and the standardised workflow from the radiologist's perspective is very similar.[17]
- *Viewpoint of the facility where the radiologist works*. The relevant issue is not whether or not the radiologist interpreting the images is physically present at the place where the patient's images are generated, but rather whether the radiological process is carried out in an integrated manner within the same service organisation (intramural) or is outsourced (extramural),[18] as the regulations, requirements, obligations and liability regimes are different in the two service models:[8,15]
  a *Intramural teleradiology.* In this model, the entire radiology process remains under the control of a single service organisation or company (Fig. 2). This scenario ensures the consolidation, stability and standardisation of both the imaging process and procedures.[8,15] In this context, there is no distinction between 'normal' radiology and teleradiology.
  b *Extramural teleradiology*. In this model, the integrated management of the radiology process is fragmented and the responsibility for different parts assigned to different parties (Fig. 3). Part of the process, including the management of referrals, justification of the scan and the generation of images, is carried out by the service that has direct contact with the patient, under the responsibility of a local radiologist. The other part of the diagnostic process (reporting) and the sending of information is outsourced (subcontracted) to a third party. This is where it is important to clearly delimit the responsibilities of each of the parties involved.[8,15] In this scenario, teleradiology is defined by the tool that enables the electronic transmission of radiology images from the organisation producing the images to the one that is responsible for interpreting them and producing diagnostic reports.

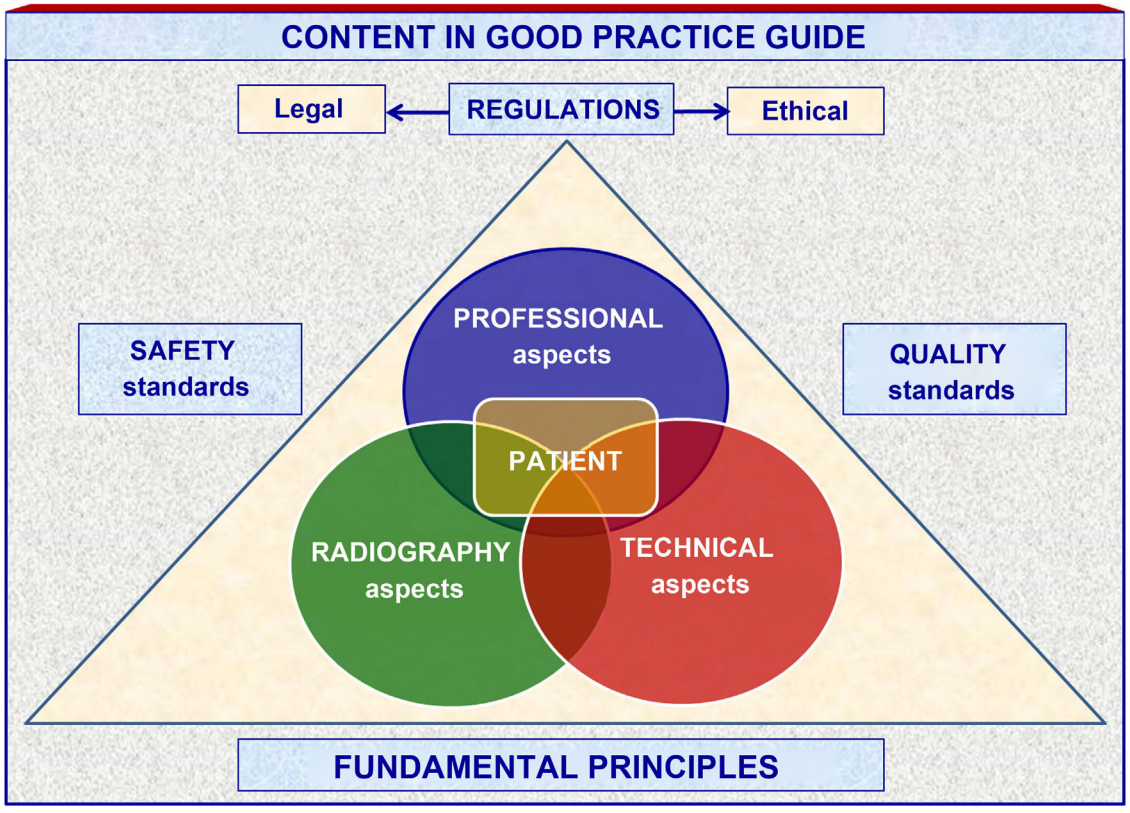

Figure 1 Content in good practice guides.

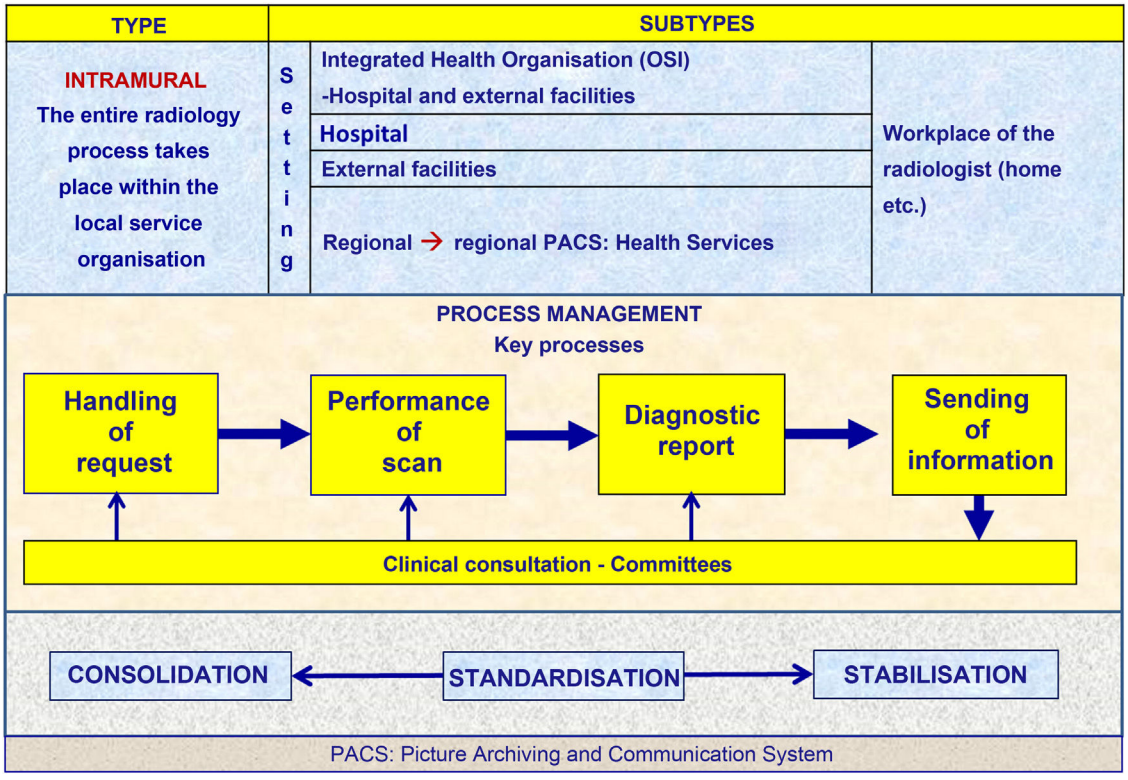

Figure 2 Intramural teleradiology.

Table 1 Good practice guides in teleradiology.

	International	
2010	United States	InterAmerican College of Radiology (AMCR). Documents on teleradiology. Policies, standards, guidelines and recommendations for the implementation of teleradiology services in member countries[1]
2014	European Union	European Society of Radiology (ESR). ESR white paper on teleradiology: an update from the teleradiology subgroup[2]
2017	Australasia	Royal Australian & New Zealand College of Radiologists (RANZCR). Standards for Teleradiology. 2017[3]
		National
2008	Canada	Canadian Association of Radiologists (CAR). Standards for Teleradiology[4]
2021	Dubai	Dubai Healthcare City Authority (DHCA). Department: Policy and Regulation-Healthcare Operators & Healthcare Professionals. DHCA Teleradiology Policy[5]
2013	United States	American College of Radiology (ACR). White Paper on Teleradiology Practice: A Report From the Task Force on Teleradiology Practice[6]
2016	United States	American College of Radiology (ACR). Report of the ACR task force on international teleradiology[7]
2015	Spain	Sociedad Española de Radiología Médica (SERAM). Decálogo de buenas prácticas en telerradiología[8]
2018	France	Conseil National Professionnel de radiologie et imagerie médicale (G4Rad). Charte de Teleradiologie[9]
2010	Italy	Istituto Superiore di Sanità (ISS). Linee guida per l'assicurazione di qualità in teleradiologia[10]
2008	Malaysia	Ministry of Health Malaysia (KKM). Guidelines On Teleradiology In Malaysia[11]
2016	United Kingdom	The Royal College of Radiologists (RCR). Standards for the provision of teleradiology within the United Kingdom Second edition[12]
2007	Singapore	College Radiologists Singapore (CRS). Teleradiology Guidelines[13]
2021	Turkey	Turkish Society of Radiology (TSR). Guidelines for the practice of teleradiology: 2021 update[14]

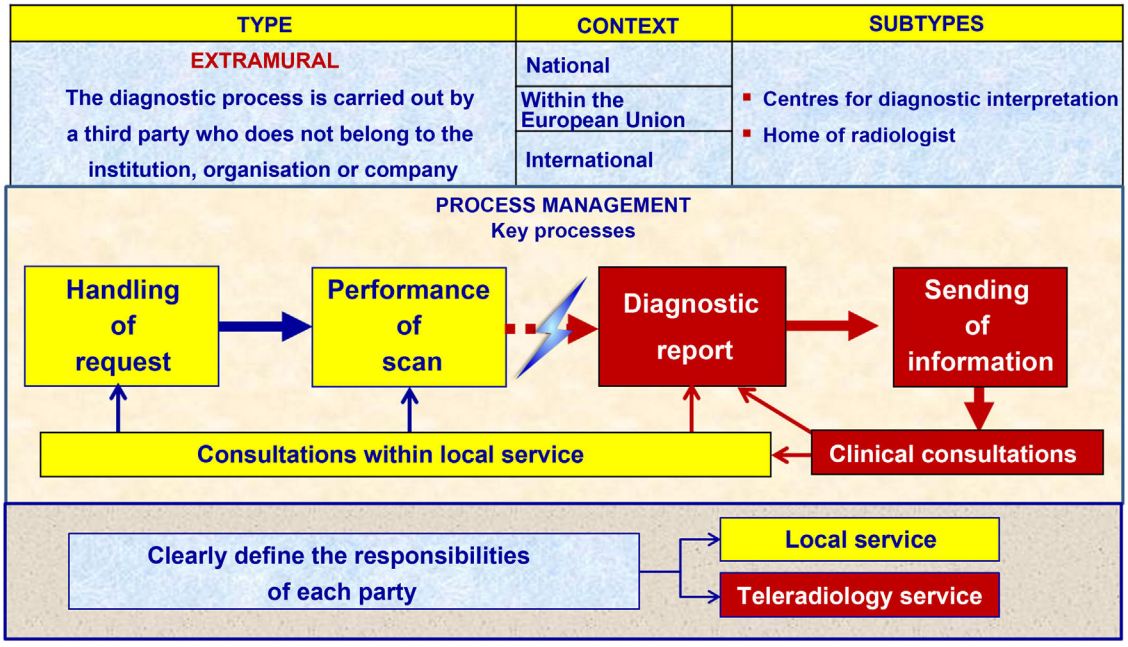

Figure 3 Extramural teleradiology.

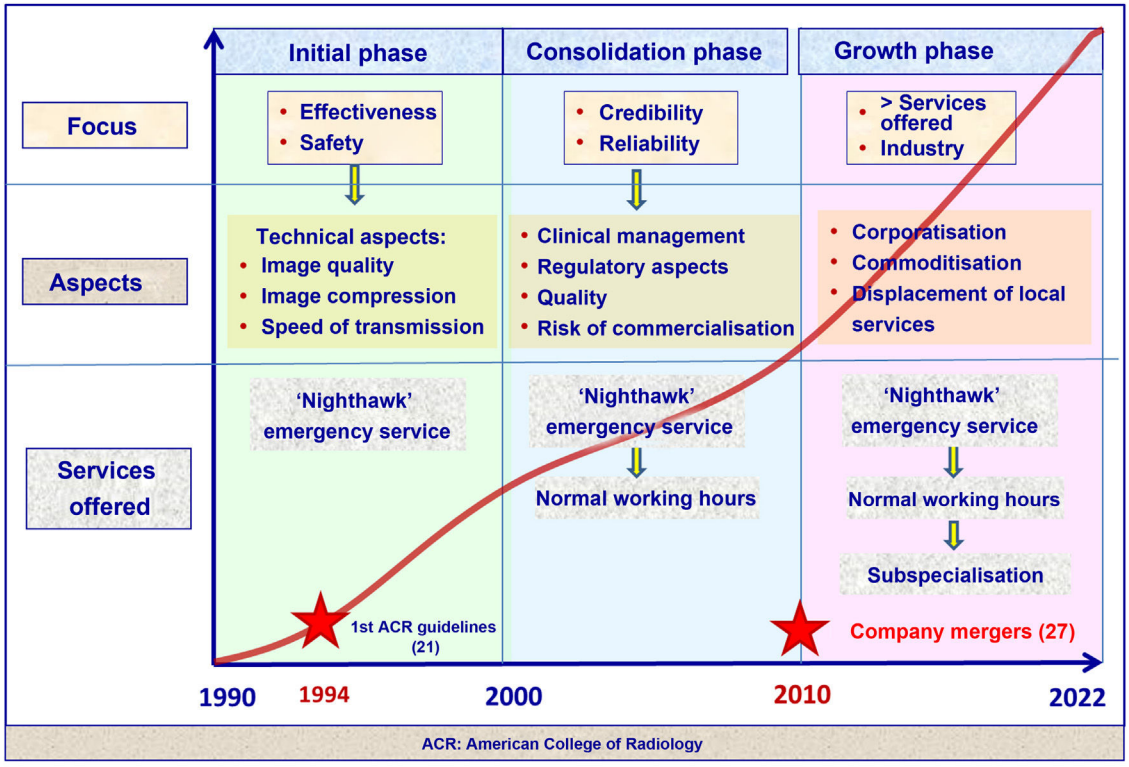

Figure 4 Phases in the development of teleradiology.

Phases in the development of teleradiology

The history of teleradiology is in many ways indistinguishable from that of digital radiology, PACS and visualisation technology.[19,20] Three phases are outlined below with regard to the focus of each phase, the content of the guides produced during that time and the services provided (Fig. 4).

- *Phase 1: 1994–2000*. De facto teleradiology has existed since 1994 when the American College of Radiology officially recognised the procedure with the publication of its first position statement on the topic.[21] This decade was dedicated to addressing initial concerns and doubts about its efficacy and safety (speed of transmission, image quality and compression), motivated by the need to provide coverage outside the ordinary working day for urgent radiology studies.[19,20,22,23] It was during this decade that the first teleradiology companies appeared on the scene, initially providing nighthawk services to cover night-shift emergency reporting for small hospitals.[22,23]
- *Phase 2: 2000–2010*. The widespread use of PACS and the increase in internet bandwidth made it possible to ensure credibility and increase supply.[19] During this period, debate focused on aspects of clinical management, medico-legal issues, quality assessment and the potential for the commercialisation of the speciality.[24–26]
- *Phase 3: 2010–2022*. Teleradiology experienced exponential growth and became an industry in its own right. In 2010, two leading US companies merged,[27] and teleradiology companies began to expand their services to meet the demands of their investors, actively seeking hospital contracts (not just after hours), thus prompting a debate on corporatisation, commoditisation and the risk of it replacing local radiology services.[28]

Review and analysis of the governing principles, standards and good practice guidelines

In the 14 documents reviewed,[1–14] 26 items have been identified and organised into the following six categories for analysis: guiding principles, legal obligations, process aspects, professional requirements, aspects related to subcontracting and technical requirements (Table 2).

Governing principles

The primary concern of teleradiology must be the best interests and benefit of the patient[1,2,5–10,12,14]

This principle is universal and fundamental, reflected in international medical ethics declarations[29] and codes of conduct[30]. Its principal objective is that teleradiology is performed for the benefit of patients and society, and never for economic reasons, convenience or opportunism.[8] The practice should be implemented to improve patient care, not to reduce costs.[15] With patient-centred radiology, respect for the patients' values and preferences is paramount.[31]

Table 2 Revision and analysis of good practice guides.

Good practice ITEM	IACR (1)	ESR (2)	RANZCR (3)	CAR (4)	DUB (5)	ACR (6.7)	SERAM (8)	G4Rad (9)	ISS (10)	KKM (11)	RCR (12)	CRS (13)	TSR (14)
1. Primary concern is the best interest and benefit of the patient	Yes	Yes	-	-	Yes	Yes	Yes	Yes	Yes	-	Yes	-	Yes
2. Quality and safety: never inferior to that provided by local radiology services	Yes	Yes	Yes	Yes	-	Yes	Yes	Yes	Yes	-	Yes	-	Yes
3. Pre-eminent position of local services: teleradiology is a complement and support to local imaging services	-	-	Yes	Yes	-	Yes	Yes	Yes	-	-	Yes	-	Yes
4. Adherence to legal requirements: Principle of the country of origin of the patient	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	-	-	Yes	Yes
5. Patient rights	Yes	-	Yes	Yes	-	-	Yes	Yes	Yes	-	-	-	-
6. Data protection and confidentiality	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
7. Consent	Yes	Yes	-	-	Yes	-	Yes	Yes	Yes	Yes	-	-	Yes
8. International teleradiology: requirements	Yes	Yes	-	-	-	Yes	Yes	-	-	-	-	-	-
9. Liability insurance	Yes	Yes	Yes	Yes	-	Yes	Yes	Yes	-	-	Yes	Yes	-
10. Contract	Yes	Yes	-	-	Yes	Yes	Yes	Yes	-	-	Yes	-	Yes
11. Incorporation into the local radiology service	Yes	-	Yes	-	Yes	Yes	Yes	Yes	Yes	-	Yes	Yes	Yes
12. Image quality: shared responsibility	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	-	-	Yes
13. Quality of diagnostic report	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
14. Access to previous studies and reports	-	Yes	-	-	-	Yes	Yes	Yes	Yes	-	Yes	-	Yes
15. Background and additional clinical information	Yes	-	-	-	-	Yes	Yes	Yes	Yes	-	Yes	Yes	Yes
16. Ensure communication with referring clinician	Yes	-	Yes	-	Yes	Yes	Yes	Yes	Yes	-	Yes	-	Yes
17. Radiation safety: radiation protection aspects	Yes	Yes	Yes	Yes	-	Yes	Yes	Yes		Yes	-	Yes	Yes
18. Accreditation, licensing, registration: teleradiologists	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	-	Yes	Yes
19. Competence of the radiologist: education and training	Yes	Yes	Yes	Yes	-	Yes	-	Yes	Yes	Yes	-	Yes	Yes
20. Ensuring the real identity of all involved parties: preventing ghost reporting	Yes	-	Yes	-	Yes	Yes	Yes	Yes	Yes	Yes	-	-	Yes
21. Requisites: radiographer (qualifications, training, under local radiologist)	Yes	Yes	Yes	Yes	-	Yes	-	Yes	Yes	Yes	-	Yes	-
22. Workplace: working environment, ergonomics	-	Yes	-	-	-	Yes	-	-	-	-	-	-	Yes
23. Remuneration of radiologists	-	Yes	-	-	-	Yes	-	Yes	-	-	-	-	Yes
24. Justified subcontracting: principle of necessity	-	Yes	-	Yes	-	-	Yes	Yes	Yes	-	-	-	Yes
25. Risk of commoditisation	Yes	Yes	-	-	-	Yes	Yes	-	-	-	-	-	-
26. Technical requirements: acquisition, transmission, visualisation, archiving	Yes	Yes	Yes	-	Yes	Yes	-	Yes	Yes	Yes	-	Yes	Yes

ACR: American College of Radiology; CAR: Canadian Association of Radiologists; IACR: InterAmerican College of Radiologists; CRS: College of Radiologists Singapore; DUB: Dubai Healthcare City Authority; ESR: European Society of Radiology; G4-Rad: Conseil National Professionnel de radiologie et imagerie médicale; ISS: Istituto Superiore di Sanità; KKM: Ministry of Health Malaysia; RANZCR: Royal Australian & New Zealand College of Radiologists; RCR: The UK Royal College of Radiologists; SERAM: Sociedad Española de Radiología Médica; TSR: Turkish Society of Radiology.

The quality and safety of teleradiology should never be inferior to that provided by local radiology services[1–4,6–10,12,14]

For any given aspect of the radiological process,[7] the standards used in teleradiology should be the same as those of local radiology services both in terms of quality[32,33] and health care safety.[34,35]

The pre-eminent position of local services: teleradiology should be used to complement and support local imaging services[3,4,6–9,12,14]

Seven guidelines emphasize the preeminence of local radiology services, expressing in different ways the preference for local teleradiology services over their outsourced equivalents.[8] Local radiologists provide the optimal clinical environment for patients and the referring clinician, as they are able to provide greater interaction and availability.[4] The on-site radiologist is the preferred model of service delivery and teleradiology is supplementary to clinical radiology.[3] The contribution of radiologists to the health care team goes beyond simply providing interpretative reports;[36] it is important for radiologists to maintain patient contact, and the services they provide in terms of teleradiology should be a complement to—and not a replacement for—their on-site practice. Under no circumstances should teleradiology become the exclusive practice of a radiologist, as this is likely to deprive them of certain professional skills in the long term.[9]

Legal aspects

Spain does not have a universal healthcare regulation covering teleradiology (nor telemedicine). However, there is a body of regulations that applies to this topic, with which professionals must comply in order to guarantee an adequate and lawful service,[8,15,37] as presented in Table 3.

It should be emphasised that responsibility for the report lies with the signatory radiologist. In this sense, and in the event of errors in the diagnosis, negligent actions or lack of diligence, this individual is responsible for any claim made by the patient or their legal representatives.

Adherence to legal requirements: Principle of the country of origin of the patient[1–10,13,14]

The link between imaging activity in the patient's country of origin and in the recipient country must not be broken. The capacity of teleradiology to cross territorial boundaries in no way impedes full compliance with the legal regulations of the place (region, country) where the patient resides. The service must be supervised at the point of origin of the activity and the competent authorities must ensure that this protection is in place. This means that the facility generating

Table 3 Legislation applicable to teleradiology.

Health legislation	
On patient rights	
General Health Law 14/1986, of 25 April	
Law 41/2002, of 14 November on the autonomy of the patient	
Directive 2011/24/EU, on the application of patient rights in cross-border healthcare. Transposition: Royal Decree 81/2014, of 7 February on the establishment of rules to ensure cross-border healthcare	
On clinical documentation	
Royal Decree 1093/2010, of 3 September, on the approval of the minimum data set for clinical reports in the national health system	
On academic training and qualifications	
Directive 2005/36, of 7 September 2005 on the recognition of professional qualifications	
Law 44/2003 of 21 November 2003 on the organisation of the health professions	
Royal Decree 183/2008, of 8 February, on the determination and classification of specialities in health sciences and the development of certain aspects of the specialised health training system	
Ministerial Order SCO/634/2008, of 15 February 2008, on the approval and publication of the training programme for the speciality of diagnostic imaging	
On the authorisation of health centres, services and establishments	
Royal Decree 1277/2003, of 10 October, on the establishment of the general conditions for the authorisation of health centres, services and establishments	
Legislation on ionising radiation	
There are more than 40 regulations. The following are those of greatest practical use:	
Royal Decree 1976/1999, of 23 December, on the establishment of quality criteria in diagnostic imaging	
Royal Decree 601/2019, of 18 October, on the use and optimisation of radiotherapy and radiological protection for medical exposure to ionising radiation	
Legislation on electronic services and commerce	
Directive 2000/31/EC, on electronic commerce. Transposition: Law 34/2002, of 11 July, on information society services and electronic commerce	
Directive 98/34/EC, on information society services (LSSI)	
Legislation on data protection	
Organic Law 3/2018, of 5 December, on the protection of personal data and the guarantee of digital rights	
Regulation (EU) 2016/679 of the European Parliament and of the Council on the protection of individuals with regard to the processing of personal data (GDPR)	
Directive (EU) 2016/1148 of the European Parliament and of the Council of 6 July on measures to ensure a high common level of security of network and information systems in the Union	
Legislation on subcontracting	
Directive 97/7/EC of 20 May 1997 on the protection of consumers in respect of distance contracts	
General legislation on contracts and obligations	Civil Code Commercial Code
Law 9/2017, of 8 November on public sector contracts	
Legislation on remote work	
Law 10/2021, of 9 July, on remote working	

the images must ensure good practice at every step of the imaging process, including any reporting carried out by third parties.[8,15,37]

Patient rights[1,3,4,8–10]

The following two types of rights are applicable:

- *Rights related to autonomy and self-determination:* right to information, right to informed consent and right to refuse the procedure.[38]
- *Rights related to the protection of privacy:* right to confidentiality of health records38 and the right to the protection of personal data.[39,40]

Data protection and confidentiality[1–14]

This aspect has been included in all the reviewed guidelines. The guide published by the European Society of Radiology deserves special attention[41] as it sets out the obligations and basic notions of confidentiality, secrecy and security measures that are relevant to radiologists in this area.

It should be noted that, due to the sensitivity of the health data being processed, robust organisational and technical measures must be implemented by the professionals working in this service. Information should be kept confidential, accessible and complete.[39,40] The following should be highlighted:

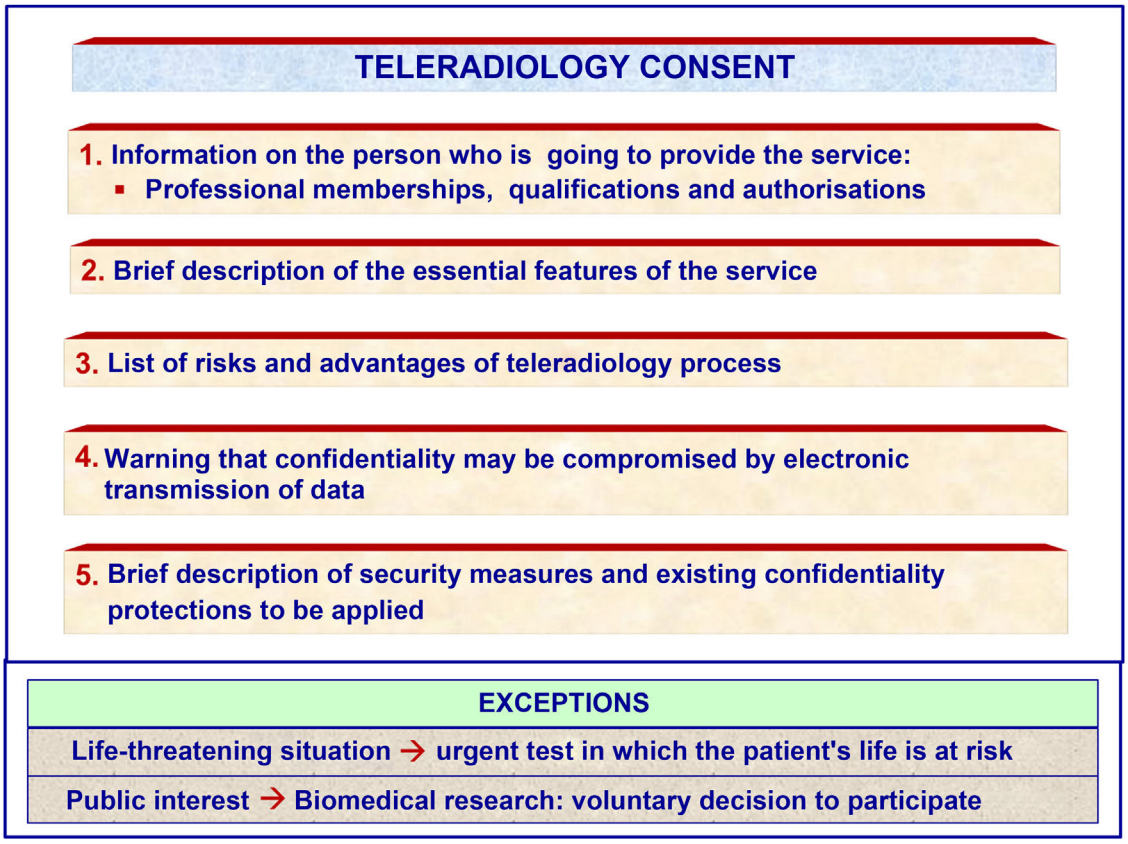

Figure 5 Content included in consent documentation.

- Data may only be accessed by authorised personnel. Authorisations and restrictions on access and permissions must be tightly controlled (for example, whether a user is only granted access to the data or permission to edit it).
- Encryption of data must be ensured at all times, both when communicating data and when storing information.

Consent[1,2,5,8–11,14]

It is necessary to differentiate between 'informed consent' for a health care intervention, which is governed by healthcare legislation,[38] and 'consent for processing of personal (healthcare) data', for which the data protection regulations apply.[39,40]

Written consent must be sought from patients whenever images from their scans are transferred outside the healthcare organisation where the scan is performed, regardless of geographic location.[8] The European guidelines state that patients should be fully informed when teleradiology is used.[2,41] It must be carried out in accordance with legal requirements.[39,40] Fig. 5 presents the content that is recommended for inclusion in the wording of this consent and exemptions.

International teleradiology: requirements[1,2,6–8]

As teleradiology has become globalised, geographical borders are no longer a barrier, and concern at the lack of regulation is expressed in some guidelines, most notably that of the American College of Radiology (ACR),[7] which states the need to set out requirements and limits governing the new international outsourcing models.

Furthermore, it is important to be aware that in the event that personal data leaves the European Economic Area, it is considered to be an international data transfer, which must be standardised in order to comply with the applicable regulations.[40] These requirements and conditions are illustrated in Fig. 6.

Liability insurance[1–4,6–9,12,13]

An insurance policy that covers this teleradiology activity and guarantees coverage in every country where it is carried out must be in place. [8,15,37]

Contract[1,2,5–9,12,14]

The following must be formalised in the case of extramural teleradiology:

- A 'service provision contract' that sets out the medico-legal responsibilities and obligations of each of the parties: both the local radiology service and the reporting teleradiology service providers.[15]
- A 'data processing agreement' which sets out the obligations of the centre as the data controller on the one hand and of the teleradiologist as the processor of personal data on the other.[40]

In the public sector, public procurement processes are governed by the Public Sector Contracts Act.[42]

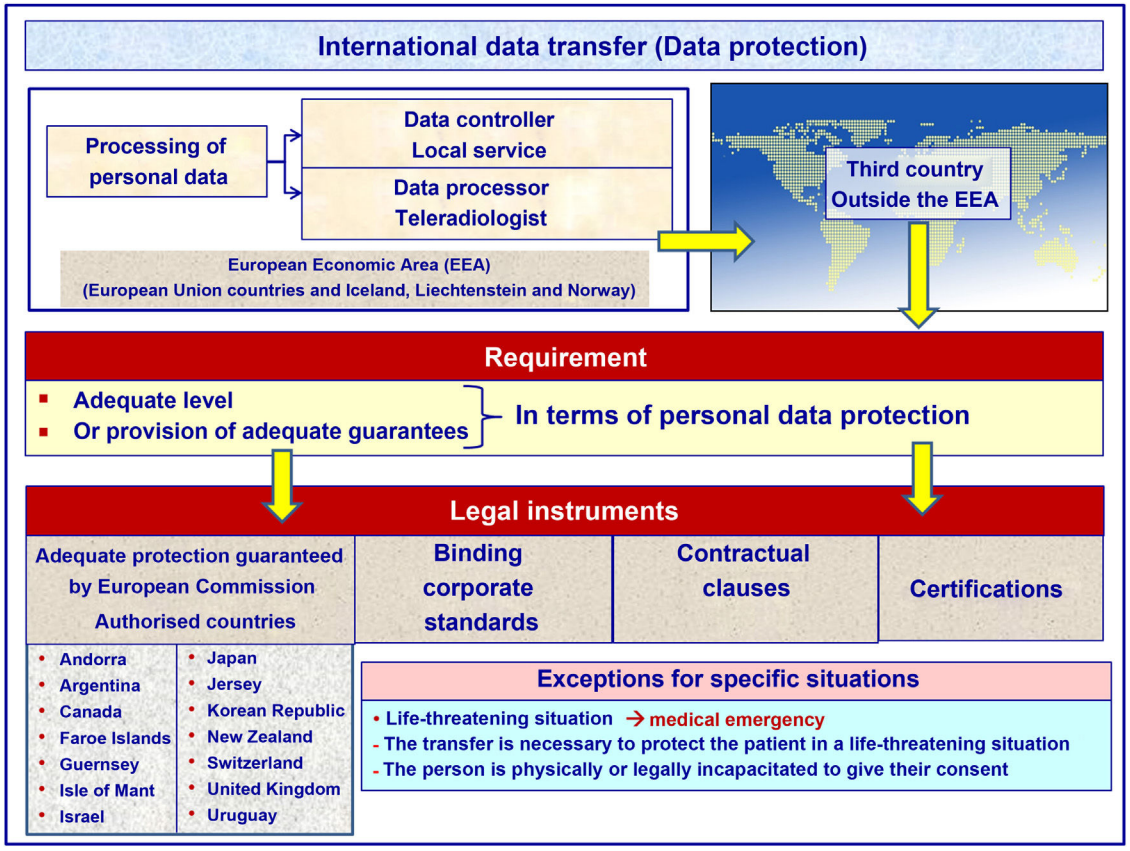

Figure 6 International data transfer.

Aspects of the imaging process

Incorporation into the local radiology service[1,3,5–10,12–14]
Teleradiology cannot be regarded as a completely separate service to local radiology and its procedures. Teleradiologists must be involved in the following activities, either directly or in a manner established by protocols signed prior to the study: justification of the scan; selection of the most appropriate imaging process (related to the clinical information provided); supervision of the imaging protocol; prescription of contrasts; patient risk management and healthcare safety. Its object is to prevent variability in quality and in scanning protocols.[43]

Image quality: principle of shared responsibility[1–11,14]
The principle of shared responsibility between the local radiologist and the teleradiologist applies. The reporting teleradiologist is responsible for the quality of the images sent, without detracting from the management and supervisory responsibilities of the local service in this respect.

Quality of reports[1–14]
This requirement is unanimously recognised in all the guidelines reviewed. The benefits of teleradiology are only fully realised when clinically useful reports are produced.[12] The form of quality control that is most strongly recommended is formal peer review.[44–46] Only one guideline recommends that the radiologist should have to produce a minimum number of reports per month to ensure quality and competence are maintained.[11] Regarding the standard of communication, most guidelines recommend those of the American College of Radiology.[47] In relation to structure, style and content, a recent publication has analysed the requirements of an organised, predefined and structured report.[48]

Access to previous reports and studies[2,6–10,12,14]
Teleradiologists must have the same standard of access to patient information regardless of whether they are working intramurally or extramurally. Access to previous studies, reports and clinical information are essential for ensuring the quality and safety of the radiology report.[8,49] The inability to access and consult previous imaging scans and reports is a major cause of malpractice[50] and a frequent source of cognitive misdiagnosis.[51]

Background and additional clinical information[1,6–10,12–14]
Apart from the obligatory clinical information, it is important that the teleradiologist is able to request any additional information. This requires open channels of communication and for the referring clinician to be accessible. This access is essential in emergency teleradiology.

Ensure communication with referring clinician[1,3,5–10,12,14]
Timely and efficient communication of diagnostic findings to clinicians is essential.[47] In concrete terms, an absence or delay in reporting critical, urgent or significant findings can have particularly serious consequences for patients, and protocols for communicating such findings must be

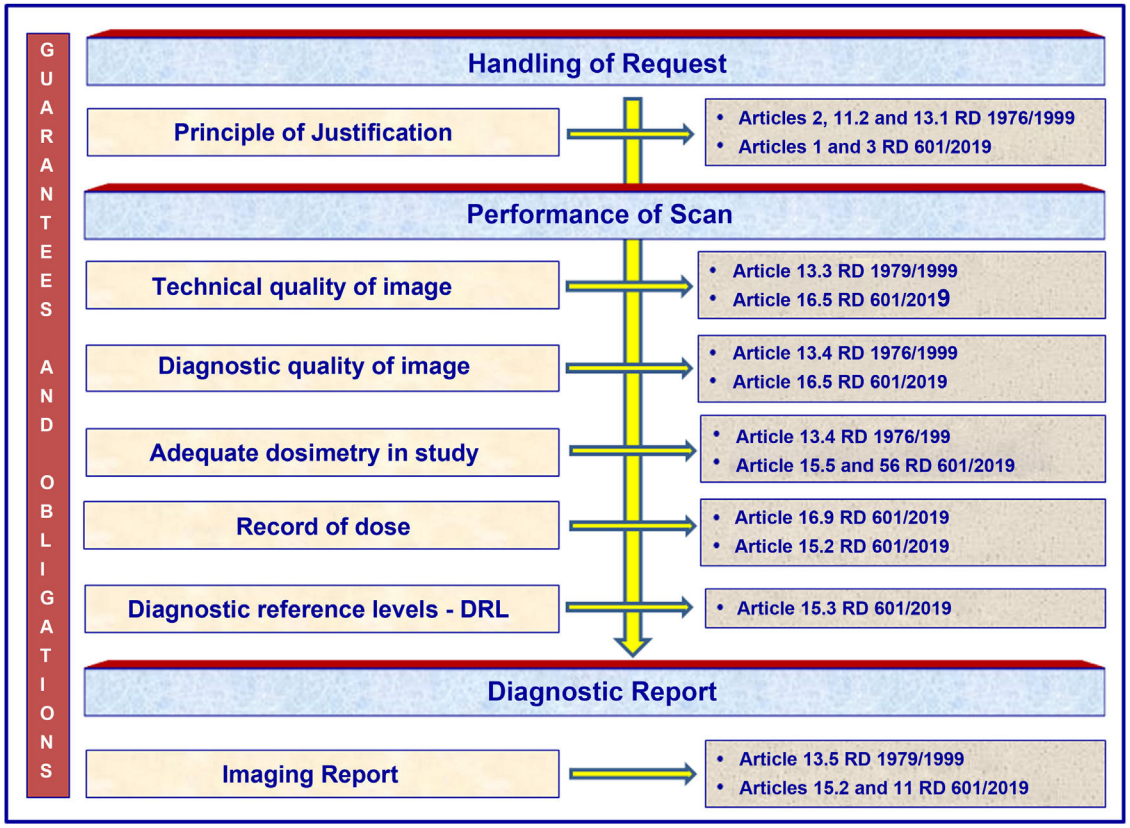

Figure 7 Radiation safety guarantees and obligations.

formalised in advance.[52] With regard to the form of communication, it is recommended that verbal feedback provided during consultations is documented in the patient's medical records.[5]

Radiation safety: radiation protection aspects[1–4,6–9,11,13,14]

Radiation safety and radiation protection legislation is still applicable to teleradiology[53–55] given that it involves regulated activities and tasks (Fig. 7). Legal responsibility lies with the head of the facility, the head of the radiology department (a local radiologist must always be assigned to the scan) and the head of the radiophysics and radiation protection department.

Professional requisites

The professional figures involved are the radiologist and the radiographer; their credential requirements, roles and responsibilities must be clearly defined.

Accreditation, qualification, licensing, registration: teleradiologists[2–11,13,14]

Guarantees must be provided that the reporting radiologist complies with the required registrations, licences and qualifications in both the country of origin where the images are produced and the country where the reporting takes place.[8,15] The requirements in Spain are listed in Fig. 8.

Competence of the teleradiologist: training and education[1–4,7,9–11,13,14]

Radiologists involved in teleradiology services should be specifically trained in this field. Training should include information on technical requirements, patient rights, legal regulations governing the protection of personal data, ethical norms, and the unintended consequences that may result from malpractice.

Ensuring the real identity of all parties involved: preventing ghost readers[1,3,5–11,14]

This is critical for the prevention of ghost readers and ghost reporting—the terms used when a second radiologist produces a report (usually at a lower price) and the contracted radiologist signs it (usually after a poor or non-existent quality check). To prevent this fraudulent practice, electronic signature systems must be used and traceability in the ICT system ensured in order to guarantee that the radiologist who signs the report is the same individual who has interpreted the images.[8,15] These fraudulent and dishonest practices must be effectively prevented and curbed; in the United States, a radiologist was imprisoned for such practices.[56] In Spain, it can constitute grounds for three criminal offences[15] (Fig. 9).

Requisites: radiographer[1–4,7,9–11,13]

The radiographer must meet all legal requirements in the country where the images are acquired. In Spain, this

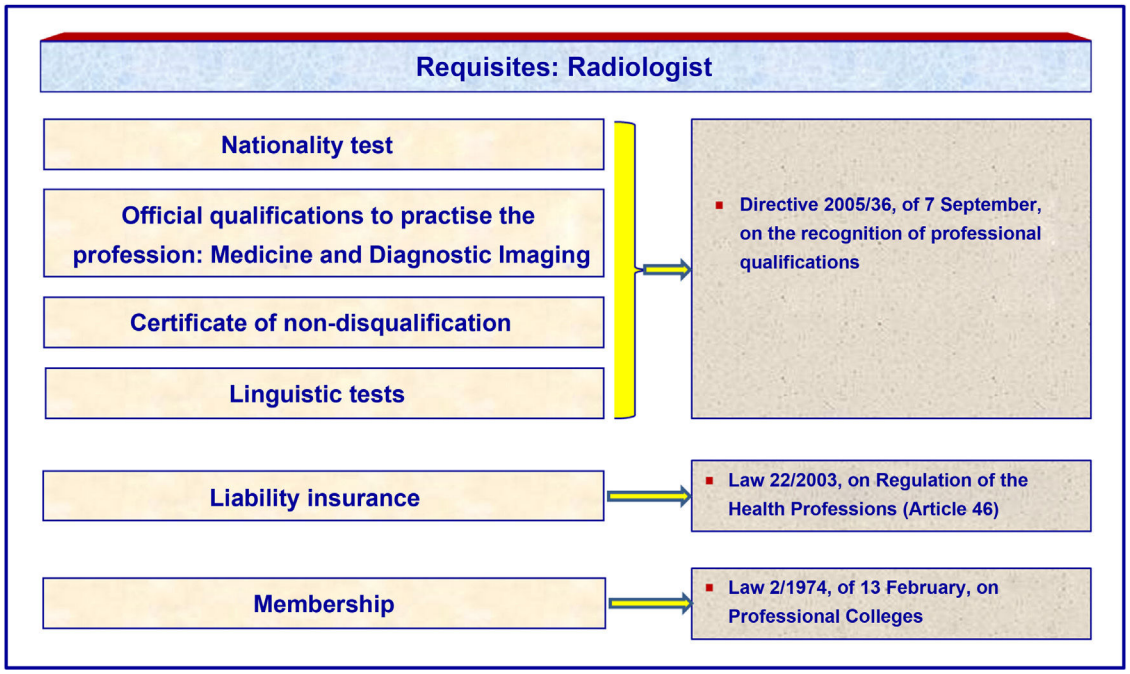

Figure 8 Legal requirements of the radiologist.

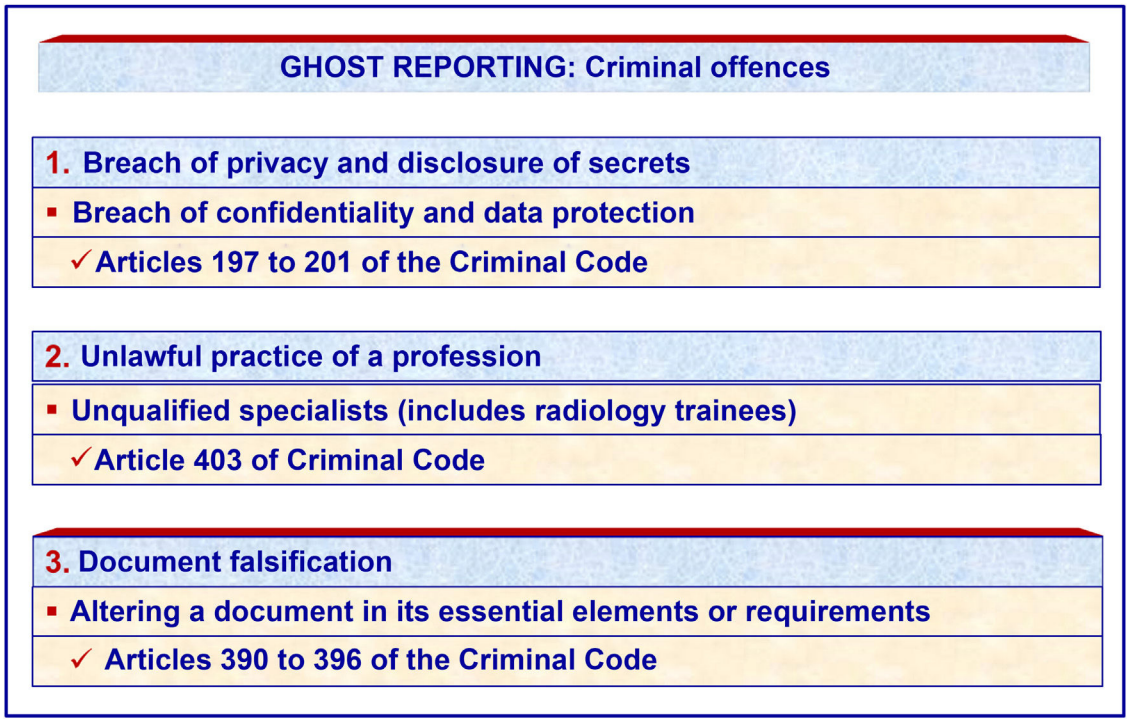

Figure 9 Criminal legal repercussions of ghost reporting.

means providing appropriate qualifications and an operator's licence from the Spanish Nuclear Safety Council. Radiographers must be trained and experienced in teleradiology (equipment/software used) and work under the general supervision of a local radiologist.

Workplace: working environment, ergonomics[2,6,7,14]
The occupational well-being of the radiologist is an important factor in determining the success of teleradiology services. The work schedule and responsibilities of the individuals involved in this activity should be planned in

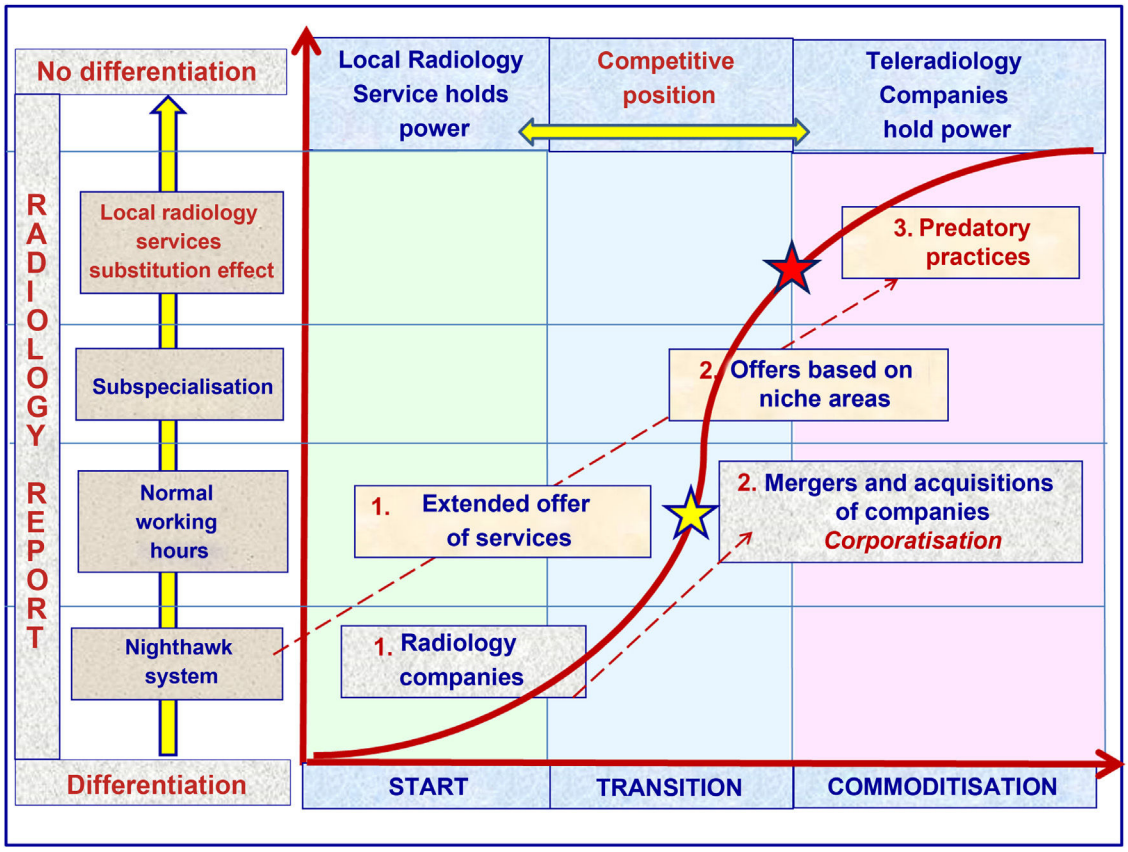

Figure 10 Phases in the development of commoditisation.

a way that does not infringe on working hours or other legal entitlements.[57] Ergonomics and comfort should also be addressed.[58]

Remuneration of radiologists[2,6,7,9,14]
A system should be in place to ensure that radiologists are properly reimbursed for the teleradiology services they provide.

Aspects related to subcontracting

Justified subcontracting and the principle of necessity[2,4,8–10,14]
These guidelines stipulate the principle of necessity as a precondition. Without a valid reason, the on-site service provided by local radiologists should not be replaced. To this end:

- A sufficient number of on-site radiologists should be employed to cover the expected workload.[14]
- Teleradiology should not be used to justify the acquisition or renovation of imaging facilities unless the required number of on-site radiologists is available to supervise them in accordance with the medical indications of the project.[9]
- The French guidelines[9] stipulate the principle of territorial priority when subcontracting: local territory in the first instance, then neighbouring territories, then provinces or even regions (before considering any outsourcing to a national commercial company).

Outsourcing has always been subject to debate[24,26,59] with a focus on the following two types of conduct:

- *Predatory commercial practices*: Some teleradiology companies seek to replace local radiology services; the end result of this approach would be a radiology service with a minimal number of radiologists.[59]
- *Disintermediation practices*: This process eliminates intermediaries from transactions. In this case, the local radiology service is excluded from negotiations which take place between hospital managers and teleradiology companies. This may even include the signing of direct contracts with no consultation with the local service providers.[60]

In summary:

- The decision to contract teleradiology services is within the scope of local radiology services, as long as it contributes to improving patient care or provides services that

local radiologists are unable to offer.
- Teleradiology should not replace or preclude the employment of radiologists and should be implemented to improve patient care, not to reduce costs.[15]
- Teleradiology projects should involve local radiologists in the decision-making processes and conditions of outsourcing.[8]

Risk of commoditisation[1,2,6–8]

Commoditisation is an economic neologism that comes from 'commodities', defined as 'raw materials' or 'basic products'. Commoditisation describes the process of converting products or services into homogeneous products or services that are indistinguishable in every way except their price.

This process has always occurred, and any sufficiently mature sector is susceptible to commoditisation, including the radiology sector.[61] This trend has been accelerated by teleradiology[62] which can turn reporting into an indistinguishable marketable commodity that can be outsourced anywhere, and in which radiologists also become interchangeable productive resources. As they are converted into commodities, differentiation disappears and the market value and bargaining power of the radiologist diminishes (Fig. 10).

Some authors argue that the commoditisation of teleradiology can offer advantages that include increased market transparency, mechanisms to guarantee medical quality and a means of attracting capital to the healthcare sector.[62]

The following three approaches are recommended in decommoditisation strategies:

- Establish specific indicators and standards to differentiate imaging services on the basis of quality and clinical outcomes.[63]
- Enhance the consultative role of the radiologist.[61]
- Contribute to the principle of efficiency.[8] This implies that in the European Union context—consisting of free market welfare states—, the primary objective of private business is to make money and the primary objective of public business is to ensure the sustainability of the system.

Technical requirements[1–3,5–7,9–11,13,14]

Technical standards of quality and safety for the proper functioning of the teleradiology system, both at the transmitting and receiving sites, must fulfil minimum technological requirements. The following guides detail the principal requirements:

- The 2022 revised technical standard[64] for the electronic practice of medical imaging by the American College of Radiology (ACR), the American Association of Physicists in Medicine (AAPM) and the Society for Imaging Informatics in Medicine (SIIM).
- The Royal College of Radiologist's (RCR) guidelines on PACS and diagnostic display devices.[65]
- The ACR reference guide in information technology for the practising radiologist.[66]

Conclusions

- Teleradiology is about much more than just reporting a scan from afar or transmitting images and information between distant points; it is also about sharing knowledge.
- It must be subject to codes of good practice agreed by scientific societies that determine its fundamental principles, establish guidelines for action based on ethical and legal norms, and define standards and indicators of quality and safety for the activity.
- When respected, codes of practice are an excellent tool that allows telecommunication and teleconsultation between referring clinicians and radiologists. Its benefits are well known, including the provision of diagnostic imaging consultation and interpretation services in areas where there is a proven need for radiologists, thus bridging the gap between specialists in one location and clinicians and patients in another. Other benefits are the provision of reports for urgent procedures and during out-of-hours periods to provide 24-h coverage; an enhanced diagnostic capability resulting from the possibility of requesting a second opinion; access to complex post-processing systems and computer-aided diagnosis; and the development of new possibilities in biomedical research and training.
- The threats it poses include risks related to outsourcing; delocalisation; cross-borderisation; commoditisation; corporatisation; its use as a service isolated from clinical practice that fractures the radiology care process; breaches of confidentiality and data protection rights; its uncontrolled and unregulated growth driven solely by commercial incentives; and the use of fraudulent and criminal practices, such as the employment of specialists without EU-recognised qualifications and the use of ghost readers.

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None.

References

1. Colegio Interamericano de Radiología (CIR). Documentos de Telerradiología. Políticas, Estándares, Guías y Recomen-

daciones para la implementación de servicios de Telerradiología en los países miembros. 2010. Available in: http://www.webcir.org/docs/teleradiologia.pdf. Consulted: 12 Agosto 2022.
2. European Society of Radiology (ESR). ESR white paper on teleradiology: an update from the teleradiology subgroup. Insights Imaging. 2014;5:1–8, http://dx.doi.org/10.1007/s13244-013-0307-z.
3. Royal Australian & New Zealand College of Radiologists (RANZCR). Standards for Teleradiology. 2017. Available in: https://www.telemedecine-360.com/wp-content/uploads/2019/02/2017-Teleradiology-RANZCR.pdf. Consulted: 12 Agosto 2022.
4. CAR Standards for Teleradiology. Canadian Association of Radiologists. 2008. isponible: https://car.ca/wp-content/uploads/Teleradiology-2008.pdf. Consulted: 12 Agosto 2022. Available in: https://car.ca/wp-content/uploads/Teleradiology-2008.pdf. Consulted: 12 Agosto 2022.
5. Dubai Healthcare City Authority. Department: Policy and Regulation- Healthcare Operators & Healthcare Professionals. DHCA Teleradiology Polici. Available in. https://dhcc.ae/gallery/TeleradiologyPolicy.pdf. Consulted: 12 Agosto 2022.
6. Silva E 3rd, Breslau J, Barr RM, Liebscher LA, Bohl M, Hoffman T, et al. ACR white paper on teleradiology practice: a report from the Task Force on Teleradiology Practice. J Am Coll Radiol. 2013;10:575–85, http://dx.doi.org/10.1016/j.jacr.2013.03.018.
7. Moore AV, Allen B, Campbell SC, Carlson RA, Dunnick NR, Fletcher TB, et al. Report of the ACR task force on international teleradiology; 2016. Available in: https://www.acr.org/Practice-Management-Quality-Informatics/Legal-Practices/Teleradiology. Consulted: 12 Agosto 2022.
8. Ayuso C, del Cura JL, Gayete À, Gómez G, Martel J, Matute F, et al. Junta Directiva de la Sociedad Española de Radiología – SERAM. Decálogo de Buenas prácticas en telerradiología. 2015. SERAM. Available in: https://seram.es/documentos-de-seram/ Consulted: 19 agosto 2022.
9. French National Radiological Council. Teleradiology Charter. 2018. Available in: http://www.sfrnet.org/Data/upload/documents/Groupe%20de%20travail/T%C3%A9l%C3%A9radiologie/Teleradiology%20Charter.pdf. Consulted: 12 Agosto 2022.
10. Gruppo di Studio per l'Assicurazione di Qualità in Radiologia Diagnostica ed Interventistica (Ed.). Linee guida per l'assicurazione di qualità in teleradiologia. Roma: Istituto Superiore di Sanità; 2010. (Rapporti ISTISAN 10/44). Available in: https://sirm.org/wp-content/uploads/2021/04/206-Rapporto-ISTISAN-10-44-teleradiologia.pdf. Consulted: 12 Agosto 2022.
11. MRS, Ministry of Health. Guidelines On Teleradiology In Malaysia. Available in: https://docplayer.net/12978976-Guidelines-on-teleradiology-in-malaysia.html. Consulted: 12 Agosto 2022.
12. Royal College of Radiology. Standards for the Provision of Teleradiology within the United Kingdom. 2nd edition; 2016. Available in: https://www.rcr.ac.uk/system/files/publication/field_publication_files/telerad_standards.pdf Consulted: 12 Agosto 2022.
13. College Radiologists Singapore. Teleradiology Guideline. 2007. Available in: https://www.ams.edu.sg/view-pdf.aspx?file=media%5C748_fi_783.pdf&ofile=2007_Teleradiology+Guidelines.pdf. Consulted: 12 Agosto 2022.
14. Özmen MN, Dicle O, Şenol U, Aydıngöz Ü. TSR guidelines for the practice of teleradiology: 2021 update. Diagn Interv Radiol. 2021;27:504–10.
15. Martí-Bonmatí L, Morales A, Donoso Bach L. Actualización: Hacia un uso adecuado de la telerradiología. Radiología. 2012;54:115–23, http://dx.doi.org/10.1016/j.rx.2011.05.020.
16. Unión Europea. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on Telemedicine for the benefit of patients, healthcare systems and society. Documento 52008DC0689. 4.11.2008. Available in: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A52008DC0689.
17. Bashshur RL, Krupinski EA, Thrall JH, Bashshur N. The empirical foundations of teleradiology and related applications: a review of the evidence. Telemed J E Health. 2016;22:868–98, http://dx.doi.org/10.1089/tmj.2016.0149.
18. Hanna TN, Steenburg SD, Rosenkrantz AB, Pyatt RS Jr, Duszak R Jr, Friedberg EB. Emerging challenges and opportunities in the evolution of teleradiology. AJR Am J Roentenol. 2020;215:1411–6, https://doi:10.2214/AJR.20.23007.
19. Thrall JH. Teleradiology. Part I. History and clinical applications. Radiology. 2007;243:613–7, http://dx.doi.org/10.1148/radiol.2433070350.
20. Reponen J, Niinimäki J. Emergence of teleradiology, PACS, and other radiology IT solutions. Acta Radiol. 2021;62:1525–33, http://dx.doi.org/10.1177/02841851211051003.
21. American College of Radiology Council. Resolution 26 (ACR position statement on remote interpretation of radiologic images (resolution 26, 1994). In: ACR Digest Council Actions. Reston (VA): American College of Radiology, 2004.
22. Bradley WG. Special focus – outsourcing after hours radiology – another point of view – use of a nighthawk service in an academic radiology department. J Am Coll Radiol. 2007;4:675–7, http://dx.doi.org/10.1016/j.jacr.2007.04.009.
23. Larson PA, Janower ML. The nighthawk: bird of paradise or albatross? J Am Coll Radiol. 2005;12:967–70.
24. Levin DC, Rao VM. Outsourcing to teleradiology companies: bad for radiology, bad for radiologists. J Am Coll Radio. 2011;8:104–8, http://dx.doi.org/10.1016/j.jacr.2010.08.017.
25. Thrall JH. Teleradiology. Part II. Limitations, risks, and opportunities. Radiology. 2007;244:325–8, http://dx.doi.org/10.1148/radiol.2442070676.
26. Boland GW. Teleradiology coming of age: winners and losers. AJR Am J Roentgenol. 2008;190:1161–2, http://dx.doi.org/10.2214/AJR.07.3114.
27. Virtual Radiologic Corp adquisicición de NightHawk Radiology. Available in: https://medcitynews.com/2010/09/virtual-radiologic-to-purchase-rival-nighthawk-for-170-million/ Consulted: 21 agosto 2022.
28. Fleishon HB, Vijayasarathi A, Pyatt R, Schoppe K, Rosenthal SA, Silva E. White paper: corporatization in radiology. J Am Coll Radiol. 2019;16:1364–74, http://dx.doi.org/10.1016/j.jacr.2019.07.003.
29. Asociación Médica Mundial. Declaración de la AMM sobre la ética de la telemedicina. Adoptada por la 58 Asamblea General de la AMM, Copenhague, Dinamarca, Octubre 2007 y enmendada por la 69ª Asamblea General de la AMM, Reykjavik, Islandia, octubre 2018. Available in: https://medicostenerife.es/wp-content/uploads/2020/05/declaracion-de-la-amm-sobre-la-etica-de-la-telemedicina.pdf.
30. Consejo General de Colegios Oficiales de Médicos. Código de Deontología Médica. Guía de Ética Médica. Madrid: OMC: 2011. Available in: https://www.cgcom.es/sites/main/files/files/2022-03/codigo_deontologia_medica.pdf Consulted: 28 Agosto 2022.
31. Itri JN. Patient centered radiology. Radiographics. 2015;35:1835–48, http://dx.doi.org/10.1148/rg.2015150110.

32. Gonzalez I, Trapero MA. La gestion en los servicios de radiología. In: Del Cura JL, Pedraza S, Gayete À, Rovira À, editors. Radiología Esencial. 2ª ed Madrid: Panamericana; 2018. p. 2205–33.
33. Hetenyi S, Goelz L, Boehmcker A, Schorlemmer C. Quality assurance of a cross-border and sub-specialized teleradiology service. Healthcare (Basel). 2022;28(10):1001, http://dx.doi.org/10.3390/salud10061001.
34. Morales A. La gestión del riesgo en el ámbito de la radiología. In: Del Cura JL, Pedraza S, Gayete À, Rovira À, editors. Radiología Esencial. 2ª ed Madrid: Panamericana; 2018. p. 2282–93.
35. Berlin L. Contemporary risk management for radiologists. Radiographics. 2018;38:1717–28, http://dx.doi.org/10.1148/rg.2018180012.
36. Patti JA, Berlin JW, Blumber AL, Bryan RN. ACR white paper: the value added that radiologists provide to the health care enterprise. J Am Coll Radiol. 2008;5:1041–53, http://dx.doi.org/10.1016/j.jacr.2008.06.003.
37. Luis Martí Bonmatí, Ángel Morales. Telerradiología. Código de conducta. Telemedicina: ingeniería biomédica / coord. Pedro Antonio Carrión Pérez, Juan Ródenas García, José Joaquín Rieta Ibáñez, César Sánchez Meléndez, 2009, ISBN 978-84-8427-631-9, págs. 35-50. Available in: https://dialnet.unirioja.es/servlet/articulo?codigo=3157595 Consulted: 3 de Octubre 2022.
38. España. Ley 41/2002, de 14 de noviembre, básica reguladora de la autonomía del paciente y de derechos y obligaciones en materia de información y documentación clínica. BOE núm. 274, de 15/11/2002.
39. España. Ley Orgánica 3/2018, de 5 de diciembre, de Protección de Datos Personales y garantía de los derechos digitales. BOE núm. 294, de 6 de diciembre de 2018, páginas 119788 a 119857.
40. Unión Europea. Reglamento (UE) 2016/679 del Parlamento Europeo y del Consejo de 27 de abril de 2016 relativo a la protección de las personas físicas en lo que respecta al tratamiento de datos personales y a la libre circulación de estos datos y por el que se deroga la Directiva 95/46/CE (Reglamento general de protección de datos). Diario oficial de la Unión Europea,. DOUE L 127 de 23.5.2018 y DOUE L 74 de 4.3.2021.
41. European Society of Radiology (ESR). The new EU General Data Protection Regulation: what the radiologist should know. Insights Imaging. 2017;8:295–9, http://dx.doi.org/10.1007/s13244-017-0552-7.
42. Ley 9/2017, de 8 de noviembre, de Contratos del Sector Público, por la que se transponen al ordenamiento jurídico español las Directivas del Parlamento Europeo y del Consejo 2014/23/UE y 2014/24/UE, de 26 de febrero de 2014. BOE núm. 272, de 09/11/2017.
43. Abramson RG. Variability in radiology practice in the United States: a former teleradiologist's perspective. Radiology. 2012;263:318–22 https://doi.org/10.1148/radiol.12112066
44. Malet A, Andreu M, Pérez- Riverola V. Control de calidad de los informes de radiodiagnóstico. Radiología. 2022;64:207–12, http://dx.doi.org/10.1016/j.rx.2022.01.001.
45. Steele JR. The role of RADPEER in the Joint Commission ongoing practice performance evaluation. J Am Coll Radiol. 2011;8:6–7, http://dx.doi.org/10.1016/j.jacr.2010.08.025.
46. Morozov S, Guseva E, Ledikhova N, Vladzymyrskyy A, Safronov D. Telemedicine-based system for quality management and peer review in radiology. Insights Imaging. 2018;9:337–41, http://dx.doi.org/10.1007/s13244-018-0629-y.
47. ACR practice parameter for communication of diagnostic imaging findings. American College of Radiology. Revised 2020 (Resolution 37). Available in: https://www.acr.org/-/media/acr/files/practice-parameters/communicationdiag.pdf Consulted: 2 Septiembre 2022.
48. Martí-Bonmatí L, Alberich-Bayarrib À, Torregrosaa A. El informe radiológico. Estructura, estilo y contenido. Radiología. 2022;64:186–93, http://dx.doi.org/10.1016/j.rx.2022.01.013.
49. Hunter TB, Boyle RR. The value of reading the previous radiology report. AJR Am J Roentgenol. 1988;150:697–8, http://dx.doi.org/10.2214/ajr.150.3.697.
50. Berlin L. Malpractice issues in radiology: comparing new radiographs with those obtained previously. AJR Am J Roentgenol. 1999;172:3–6, http://dx.doi.org/10.2214/ajr.172.1.9888727.
51. Morales A. Gestión de riesgos del informe radiológico. Especial referencia al error diagnóstico. Radiología. 2022;64:194–6, http://dx.doi.org/10.1016/j.rx.2022.01.012.
52. Standards for the communication of radiological reports and fail-safe alert notification. The Royal College of Radiologist – RCR. 2016. Available in: https://www.rcr.ac.uk/system/files/publication/field_publication_files/bfcr164_failsafe.pdf.
53. España. Real Decreto 601/2019, de 18 de octubre, sobre justificación y optimización del uso de las radiaciones ionizantes para la protección radiológica de las personas con ocasión de exposiciones médicas. BOE núm. 262, de 31 de octubre de 2019, páginas 120840 - 120856.
54. Unión Europea. Directiva 2013/59/Euratom del Consejo, de 5 de diciembre de 2013, por la que se establecen normas de seguridad básicas para la protección contra los peligros derivados de la exposición a radiaciones ionizantes, y se derogan las Directivas 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom y 2003/122/Euratom. DOUE núm. 13, de 17 de enero de 2014, páginas 1 a 73.
55. España. Real Decreto 1976/1999, de 23 de diciembre, por el que se establecen los criterios de calidad en radiodiagnóstico. BOE» núm. 311, de 29 de diciembre de 1999, páginas 45891 a 45900.
56. US Department of Justice, The United State Attorney's Office, Northern District of Georgia. Atlanta radiologist sentenced to prison. December 9, 2011. Available in: https://www.justice.gov/archive/usao/gan/press/2011/12-09-11b.html.
57. Gobierno de España. Ley 10/2021, de 9 de julio, de trabajo a distancia. BOE núm. 164, de 10 de julio de 2021, páginas 82540 a 82583.
58. Glover A, Whitman G, Kyungmin Shin K. Ergonomics in radiology: improving the work environment for radiologists. Curr Probl Diagn Radiol. 2022;5:680–5, http://dx.doi.org/10.1067/j.cpradiol.2022.03.001.
59. Brady AP, Becker CD. Teleradiological outsourcing—compromises and hidden costs. Eur Radiol. 2019;29:1647–8, http://dx.doi.org/10.1007/s00330-019-6014-5.
60. Muroff LR. National entrepreneurial radiology initiatives: what are they, and what can they do to and for you? J Am Coll Radiol. 2013;10:247, http://dx.doi.org/10.1016/j.jacr.2012.09.024.
61. Krestin GP. Commoditization in radiology: threat or opportunity? Radiology. 2010;256:338–42, http://dx.doi.org/10.1148/radiol.10100144.
62. McLean T. Commoditization of the international teleradiology market. J Health Serv Res Policy. 2007;12:120–2, http://dx.doi.org/10.1258/135581907780279503.
63. Reiner BI, Siegel EL. Decommoditizing radiology. J Am Coll Radiol. 2009;6:167–70, http://dx.doi.org/10.1016/j.jacr.2008.11.004.
64. American College of Radiology. ACR–AAPM–SIIM Technical Standard for Electronic Practice of Medical Imaging. Revised 2022 (Resolution 48). Available in: ACR–AAPM–SIIM Technical Standard for Electronic Practice of Medical Imaging.

65. The Royal College of Radiologist – RCR. Picture archiving and communication systems (PACS) and guidelines on diagnostic display devices. third edition; 2019. Available in: https://www.rcr.ac.uk/system/files/publication/field_publication_files/bfcr192_pacs-diagnostic-display.pdf.

66. American College of Radiology website. Reference guide in information technology for the practicing radiologist. Available in: https://www.acr.org/Practice-Management-Quality-Informatics/Informatics/Reference-Guide.