

## UPDATE IN RADIOLOGY

# Online training in radiology during the COVID-19 pandemic

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**Abstract** The COVID-19 pandemic has changed the methods used for teaching radiology in medical schools, residency programs, and continuing medical education. The need to continue training in radiology in a situation requiring physical distancing has led to the massive use of online methods, and this is where internet has provided a solution to mitigate the problem. This paper aims to present a series of useful, freely accessible resources that share the #FOAMRad philosophy for online training in radiology during the COVID-19 pandemic.

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**PALABRAS CLAVE**

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**Formación online en Radiología en tiempos de COVID**

**Resumen** La pandemia por COVID-19 ha alterado de forma significativa la metodología que tradicionalmente se ha empleado para la enseñanza de la RADIOLOGÍA en pregrado, posgrado y formación continuada. La necesidad de continuar con la formación en Radiología bajo una situación de distanciamiento físico ha provocado el uso masivo de metodología *online* y aquí es donde Internet se ha constituido en una solución para mitigar el problema. El objetivo de este trabajo es presentar una serie de recursos útiles de acceso gratuito que comparten la filosofía #FOAMRad para la formación *online* en Radiología en estos tiempos de COVID.

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**Introduction**

The COVID-19 pandemic has significantly altered the methods traditionally used to teach Radiology in undergraduate,

postgraduate and continuing education.<sup>1–4</sup> The suspension of face-to-face classes and clinical placements has had a negative impact on the theoretical and practical training of students of Medicine.<sup>2</sup> In Radiology departments, the relocation of resident interns and specialist radiologists to other departments to carry out functions of other specialties, and the physical distance between residents and the specialist radiologists who supervise them, have unde-

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nably contributed to limiting postgraduate training.<sup>3</sup> The suspension of clinical sessions, meetings of multidisciplinary committees and conferences, courses and congresses has put a brake on the continuing medical training of specialist radiologists. These obstacles have led to the search for alternatives to alleviate the negative consequences of the pandemic on Radiology training and have led to the extensive use of other teaching methods.<sup>1,2,5-8</sup>

The need to continue training in radiology in a situation requiring physical distancing has led to the massive use of online methods, and this is where internet has provided a solution to mitigate the problem.<sup>1,2,5-8</sup> The massive use of communication platforms for the live transmission of webinars and congresses has become popular, with Zoom probably being the most used.<sup>9</sup> The Girona Imaging Diagnosis and Treatment Continuing Education Platform, directed by Dr Salvador Pedraza, is a good example of the use of Zoom to give free-access web-based online continuing education seminars (Fig. 1). This platform has made it possible to keep clinical sessions going during the pandemic and is accredited by the Consell Català de la Formació Continuada de les Professions Sanitàries [Catalan Council for the Continuing Education of Healthcare Professions]. Between 1 February 2021 and 11 March 2022, 228 sessions were held (S. Pedraza [personal communication], 19 May 2022).<sup>10</sup> Free-access internet training resources have also been used on a huge scale.<sup>11</sup> The collection of free training resources on the internet in medicine is generically referred to as Free Open Access Meducation (FOAM). FOAM is a term coined in June 2012, although its philosophy is older and includes blogs, podcasts, tweets, online videos, text documents, photographs, Facebook groups and more. FOAM should be considered as an aid to medical training and is in no way intended to replace it. FOAM resources need to be easily accessible and portable, making them ideal for asynchronous learning and the flipped classroom model.<sup>12</sup> Unlike the traditional model, in which the students attend the lessons given by the teacher and then do the assigned tasks or homework, in the flipped classroom model, the students first study the theoretical concepts provided by the teacher and the classroom time is used to answer questions, do practical activities and engage in relevant debates with the content.<sup>13</sup> The FOAM resources in general medicine can be found searching for the hashtag #FOAMed. In radiology, the hashtag used to search for free resources is #FOAMRad. During the pandemic, lists of online resources organised into directories have been generated, such as the document #FOAMRad Resources<sup>14</sup>, accessible via <https://bit.ly/foamrad>, created and updated by Dr Patricia Salazar, from the University of Emory (United States). Other free and up-to-date radiology training resource listings are the general radiology resource directory *RadiologyEducation.com*<sup>15</sup> and the paediatric radiology resource directory *PediatricRadiology.com*<sup>16</sup>, both maintained by paediatric radiologist Dr Michael P. D'Alessandro, from the University of Iowa (United States).

Social media have been used in radiology training and are a resource which has also been used for this purpose during the COVID-19 pandemic.<sup>17-20</sup>

The aim of this article is to present a series of useful free-access resources which share the #FOAMRad philosophy

for online training in radiology in these times of COVID-19. The list of available resources is very extensive and those selected are the most relevant from the author's point of view.

## General basic resources

### General websites

A number of websites can be considered general as they do not specialise in any specific subspecialty of radiology. They are up-to-date and are visited daily by thousands of users.

*Introduction to Radiology* (<https://introductiontoradiology.net/>) is an interactive online tutorial from the University of Virginia Health System in Charlottesville (United States). It is a classic radiology website which covers various basic topics with mixed organisation of contents, although mainly by organs and systems.<sup>21</sup>


*Learning Radiology* (<http://learningradiology.com/index.htm>) is a website developed and maintained by Dr William Herring, from the Einstein Medical Center in Philadelphia (United States), which was created with the aim of replacing the paper notes that accompanied the lectures for medical residents and medical students. Its focus is mainly on classic conventional radiology. It currently has more than 5000 pages of contents and is very popular, with more than 10,000 visitors a day and over 23 million pages of content viewed each year. This website has given rise to the publication of the bestselling textbook *Radiology: Recognizing the basics*, which is currently in its fourth edition in English and which also has an edition in Spanish. The website also makes extensive use of social networks, with more than 800,000 followers in total, a YouTube channel and Facebook, Twitter and Instagram accounts (Fig. 2).<sup>22</sup>

*Radiology Assistant* (<https://radiologyassistant.nl/>) is the educational website of the Radiological Society of the Netherlands. It was created by Dr Robin Smithuis with the aim of providing up-to-date and free education to radiology residents and radiologists. The information it offers is focused on common clinical problems where imaging plays a major role in patient care and the superb diagrams and text really stand out. *Radiology Assistant* is also a non-profit organisation and has the status of public benefit organisation (PBO [Algemeen Nut Beogende Instelling; ANBI in the Netherlands]). In addition to the aim of providing radiology education, they assist in medical care in Southeast Asia. Although it is a free-access website, they also offer a paid application for iOS and Android mobile devices, and the profits are used for their activities as a PBO.<sup>23</sup>

*Radiopaedia* (<https://radiopaedia.org/>) is a free radiology resource based on Wikitechnology which aims to compile the knowledge and experience of radiologists and other healthcare professionals from around the world to create the best world reference in radiology. Collaboration on this Wiki is open and anyone can contribute and even modify the contents, which are reviewed by editors and expert advisers before final publication. It is currently the most visited radiology website in the world. The educational material it contains can essentially be divided into articles, case reports and case report playlists.<sup>24</sup>

IMAGING DIAGNOSIS AND TREATMENT CONTINUING EDUCATION PLATFORM. 7-11 March 2022			
DAY	TIME	SPEAKER	SUBJECT
07/03	MORNING	GORKA	Indications for cardiac
	8:00 am	BASTARRIKA	MRI
09/03	MORNING	SEBASTIÀ	Quantification methods in PET and SPECT
	8:00 am	RUBI	nuclear neuroimaging in clinical practice
10/03	MORNING	IRENE	Breast cancer early detection
	8:00 am	GARCIA	programme
11/03	MORNING	JUAN RAMON	Staging of rectal cancer and assessment
	8:00 am	AYUSO	of treatment response

 <p>Catalan Council for Continuing Training for Healthcare Professions Commission for Continuing Education of the Spanish National Health Service Service Healthcare Professions (09/031698-MD). 19 hours. 2.4 credits.</p>	<p>ACCESS TO THE SESSION: <a href="https://zoom.us/webinar/join/4916141709538?pwd=0MXz4nH2QCqhamU6-zt7w">https://zoom.us/webinar/join/4916141709538?pwd=0MXz4nH2QCqhamU6-zt7w</a></p>
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<p>The new link to register in the archive <a href="https://morninglabs.hubspotpagebuilder.com/sessions-image-m%C3%A9dica">https://morninglabs.hubspotpagebuilder.com/sessions-image-m%C3%A9dica</a></p>
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<p>ARCHIVE ACCESS: <a href="https://web.sessions.com/">https://web.sessions.com/</a>. User. Your email. Password. Your Spanish ID No. Organisation: imaging-medical</p>
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**Figure 1** Girona Imaging Diagnosis and Treatment Continuing Education Platform. This platform has made it possible to maintain clinical sessions during the pandemic and is a good example of the use of Zoom to conduct online accredited continuing education webinars.

## Collections of cases

Training in radiology is very dependent on being able to view images and recognise findings, so radiology case collections are a key tool. There are a number of collections on the Internet with thousands of cases, usually organised by organs and systems.

*Eurorad* (<https://www.eurorad.org/teaching-cases>) is a peer-reviewed educational website supported by the European Society of Radiology (ESR) which, based on radiology cases, aims to provide an educational environment for radiologists, radiology residents and students from all over the world. The cases can be studied as complete cases with a known diagnosis or as problem cases with the diagnosis to be resolved. Collaboration on *Eurorad* is open and anyone can contribute with case reports, which are reviewed by editors before final publication. It currently contains more than 7500 cases that can be searched by diagnosis, keywords or organ and system section. Each case contains relevant medical history, imaging findings, discussion, differential diagnosis, final diagnosis and references, and is assigned a Digital Object Identifier (DOI) enabling it to be cited.<sup>25</sup>

*The RSNA Case Collection* (<https://cases.rsna.org/>) is the online collection of radiology cases of the Radiological Society of North America (RSNA), developed and created by radiologists and also peer-reviewed. The aim is for it to be used as an educational tool and for clinical decision making. The cases are organised by radiological subspecialty and consist of images, relevant clinical information about the case, differential and final diagnosis, discussion and references. Collaboration is open and anyone can contribute cases, with each case assigned a DOI so it can be cited.<sup>26</sup>

*MedPix* (<https://medpix.nlm.nih.gov/home>) is a free-access online database of medical images, cases and clinical topics that currently includes more than 12,000 cases, 9000 topics, and nearly 59,000 images and is sponsored by the US National Library of Medicine (NLM). Collaboration on *MedPix* is open, so anyone can contribute with cases, which are reviewed by editors. The material is organised by organs and systems, pathology category, signs and symptoms, etc. Cases can be searched using various descriptors. It also offers free online AMA CME Category 1 credits.<sup>27</sup>

## Curricula in radiology

A number of different radiology scientific institutions and organisations sponsor websites from which basic curricula can be accessed which really are quintessential study plans in radiology.

*Radiology Resident Core Curriculum Lecture Series* (<https://radiologyresidentcorelectures.com/>) is a website supported by the Association of University Radiologists (AUR) in the United States, from which we can access a series of 20–30 min online lectures, created specifically for radiology residents and delivered by some of the best teachers from the different radiology subspecialties in the US. The goal is to provide a series of free access lectures organised by radiology subspecialties that make up the core curriculum for diagnostic radiology.<sup>28</sup>

*Cleveland Clinic Pediatric Radiology* (<https://www.cchs.net/onlinelearning/cometvs10/pedrad/default.htm>) is a website run by the Cleveland Clinic (United States) which consists of a full curriculum in paediatric radiology provided through tutorials organised into learning modules.



**Figure 2** LearningRadiology. Website designed and maintained by Dr William Herring, from the Einstein Medical Center in Philadelphia (United States), which was created with the aim of replacing the paper notes that accompanied the lectures for medical residents and medical students (<http://learningradiology.com/index.htm>).



For each of its 65 learning modules, a certificate of completion can be obtained after passing a multiple-choice test. About 25,000 students and 400 residency programmes are registered on this website.<sup>29</sup>

The *BSNR Educational Programme* (<https://bsnr.org.uk/education/modules/>) is a structured online programme of webinars covering the basic curriculum for training in diagnostic neuroradiology from the British Society of Neuroradiologists (BSNR). The total duration of the programme is two years and it is mainly aimed at residents in their final years of training in radiology. The webinars are broadcast weekly and, although they are free, in order to attend you have to be previously registered. It is also possible to access the recordings of the seminars already broadcast through the link <https://bsnr.org.uk/education/recordings/>.<sup>30</sup>

### Subspecialty websites

There are a number of websites on radiology subspecialties it is useful to know about because of their quality and their eminently educational mission.

*Breast Rads* (<https://breastrads.com/>) is a breast radiology educational platform created and maintained by Dr Charmi Vijapura, from the Department of Radiology at the University of Cincinnati (United States). It contains a core collection of reference cases for exam preparation and rotations, a mammography/ultrasound case collection and an MRI case collection, reference guides, articles and lectures.<sup>31</sup>

*Learn Abdominal Radiology* (<https://www.learnabdominal.com/home>) is an educational abdominal radiology website for medical students, residents and medical specialists created by Dr Michael Hartung, from the University Wisconsin in Madison (United States). It contains a five-day virtual elective course on abdominal computed tomography (CT) for medical students, residents and fellows, with beginner and advanced level cases, created specifically to aid training in abdominal radiology during the COVID-19 pandemic. This website contains a lot of material, including how to read a CT of the abdomen/pelvis and how to report on one, a general collection of CT cases, and a collection of abdominal MRI cases.<sup>32</sup>

*Learning Neuroradiology* (<https://sites.google.com/a/wisc.edu/neuroradiology/home>) is a website created by Dr Tabby Kennedy from the University of Wisconsin in Madison (United States), whose goal is to teach the fundamentals of neuroradiology. As in the previous case, it also contains a five-day elective virtual rotation in neuroradiology with goals to be met and a syllabus. The content includes sections dedicated to medical imaging techniques, skull and spinal anatomy, how to read a skull CT and description of basic pathologies, among others.<sup>33</sup> Dr Tabby Kennedy's teaching work in neuroradiology has been recognised by a number of different American scientific societies with various awards and her great educational efforts on the internet have certainly contributed to this recognition<sup>34,35</sup> (Fig. 3).

*Learn Neuroradiology* (<https://learnneuroradiology.com/>) is a website dedicated to neuroradiology, edited by Dr Brent Weinberg, from the University of Emory, Dr Michael Hoch, from the University of Pennsylvania and Dr Katie Carpenter Bailey, from the University of South Florida, all in the United States. Although intended primarily for radiologists, including residents, fellows and specialist radiologists, it may also be useful to non-radiologists, medical students and others. This website contains extensive amounts of material and is essentially structured into a series of short videos, publications or articles which describe different topics related to neuroradiology and is organised mainly by diseases or pathologies. All the educational videos that appear on the website can be found on its YouTube channel.<sup>36</sup>

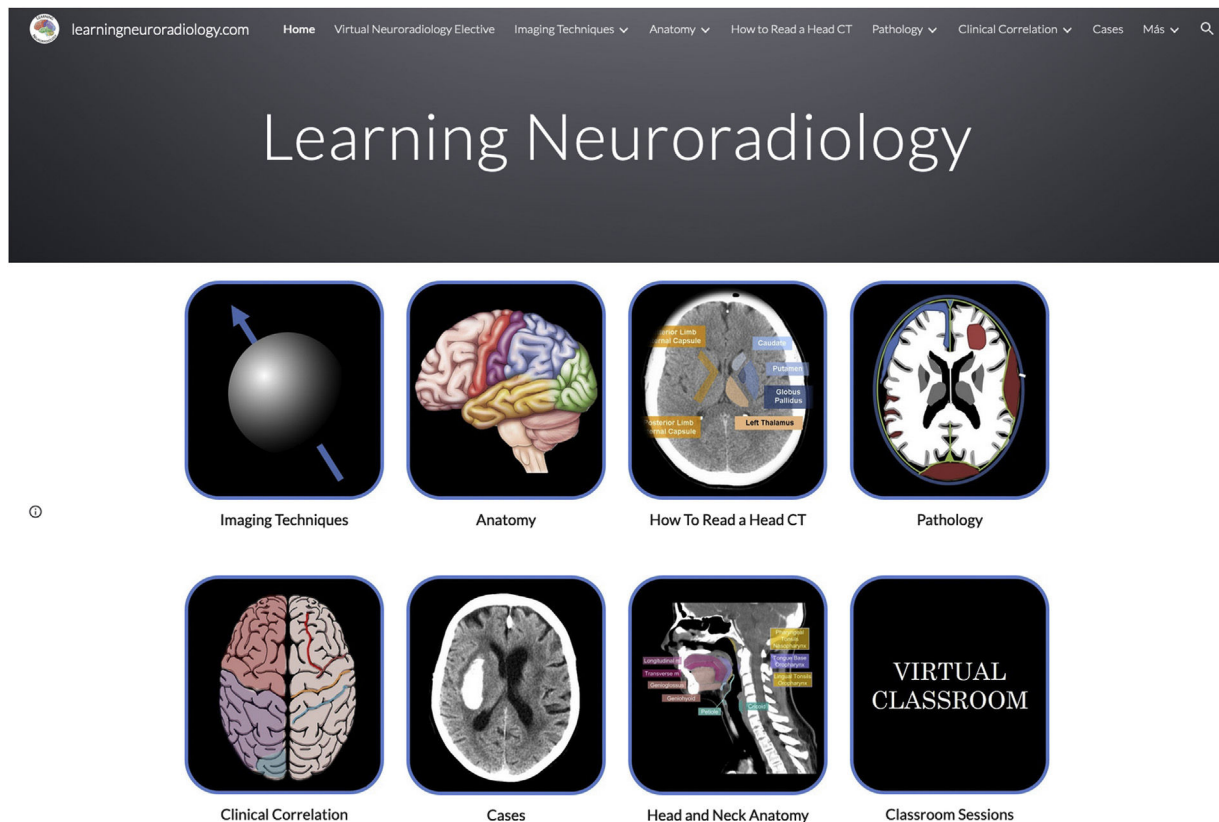
*Learning Head and Neck Radiology* (<https://www.learningheadandneck.com/>) is an educational website edited by Dr Tabby Kennedy of the University of Wisconsin in Madison (United States), who is also editor of the above-mentioned *Learning Neuroradiology*. It is dedicated to head and neck radiology, and its contents are divided into how to read a neck CT, neck anatomy with CT, head and neck cases, and virtual classroom.<sup>37</sup>

*Pediatric Imaging* (<https://pediatricimaging.org/>) is a website which contains a paediatric radiology text book and digital library and is edited by Dr Michael P. D'Alessandro, from the University of Iowa (United States). It includes more than 100 paediatric radiology differential diagnoses and covers more than 700 paediatric diseases, illustrated with more than 800 case reports. It is currently visited by more than 6000 users a day.<sup>38</sup>

*Teaching IR* (<https://www.teachingir.com/>) is an educational website on vascular/interventional radiology edited by Dr Jeff Elbich, from Virginia Commonwealth University in Richmond (United States). It is aimed at preparation for the US Radiology Core Exam through comprehensive teaching and interactive questions. After registering on the website, the user has access to a learning progress monitoring panel, a curriculum organised as a learning guide divided by year of residency, with objectives, educational material and questions, and an illustrated anatomy module with cases.<sup>39</sup>

### Social media

We should differentiate social networks from social media. Social media are a group of internet applications developed from the Web 2.0 model which enable the creation and exchange of user-generated content.<sup>40,41</sup> The Web 2.0 model allows the two-way flow of information between users while the previous Web 1.0 model, prior to 2004, only allowed one-way exchange of information between the generator and the end user.<sup>17</sup> An online or virtual social network is an internet community where individuals interact, often using profiles that present their public persona and network to others, using social media.<sup>42</sup>



**Figure 3** Learning Neuroradiology. Website created by Dr Tabby Kennedy, from the University of Wisconsin in Madison (United States), whose goal is to teach the fundamentals of neuroradiology. Dr Tabby Kennedy's educational work in neuroradiology has been recognised with various awards from different US scientific societies (<https://sites.google.com/a/wisc.edu/neuroradiology/home>).

**Table 1** Popular YouTube channels dedicated to Radiology education (accessed 4 May 2022).

Name of channel	Subscribers	Videos	Date created	Viewings
RadiologyChannel	120,000	91	22/09/2012	4,566,010
123Radiology	105,000	100	17/12/2011	14,632,682
Radiology Video-Radiology Made Easy	66,600	799	30/11/2011	7,739,245
Navigating Radiology	60,400	32	08/01/2016	2,605,412
Radiology and Imaging for Students	51,700	82	20/01/2020	2,352,590
Radiology Nation	39,600	15	08/02/2017	2,506,379
Yale Radiology and Biomedical Imaging	37,200	145	23/09/2015	2,396,781
CTisUS	33,100	2459	22/09/2009	3,071,670
Chris Beaulieu	32,000	47	09/08/2008	2,418,866
Educational Radiology Channel ERC	23,700	1286	28/03/2015	812,676
Radiology Residency UM/JMH	23,100	31	08/06/2014	1,462,901
Radiology Headquarters	13,700	57	13/03/2016	425,651
Radiology Education by Joseph W. Owen, MD	6590	81	29/06/2011	334,518

Modified from Staziaki et al.<sup>52</sup>

According to data from February 2022, there are currently 40.7 million social media users in Spain (87.1% of the population), with their number having progressively increased since social media were introduced.<sup>43</sup> The most used are WhatsApp (91%), Facebook (73.3%), Instagram (71.7%) and Twitter (46.7%).<sup>43</sup> In the last sur-

vey consulted in 2022, YouTube was not included as a social medium; however, the same survey in January 2021 showed YouTube as the second most used social media, with a high percentage of users (89.3%) immediately behind WhatsApp (89.5%),<sup>44</sup> which confirms its importance.

**Table 2** Social media in medical imaging societies in Spain. SERAM's Twitter, Instagram and Facebook accounts, various accounts associated with SERAM and accounts of SERAM's affiliates (accessed 4 May 2022).

Scientific society	Twitter account	Instagram account	Facebook account
Sociedad Española de Radiología Médica (SERAM)	@SERAM.RX	seramrx	<a href="https://www.facebook.com/rxseram">https://www.facebook.com/rxseram</a>
Residentes SERAM [SERAM Residents]	@residentesSERAM	residentes.seram	–
Club Bibliográfico SERAM [SERAM Literature Club]	@cbSERAM	–	–
Revista Radiología [Radiology Journal]	@RevistaRADIOLO2	–	–
Sociedad Española de Diagnóstico por Imagen del Abdomen (SEDIA) [Spanish Abdominal Diagnostic Imaging Society]	@sediabdomen	sediabdomen	<a href="https://www.facebook.com/sedia.abdomen.1">https://www.facebook.com/sedia.abdomen.1</a>
Sociedad Española de Neurorradiología (SENR) [Spanish Society of Neuroradiology]	@SENR.org	–	<a href="https://www.facebook.com/profile.php?id=100057663870719">https://www.facebook.com/profile.php?id=100057663870719</a>
Sociedad Española de Radiología Musculoesquelética (SERME) [Spanish Society of Musculoskeletal Radiology]	@MSKSerme	mskserme	–
Sociedad Española de Imagen Cardiotorácica (SEICAT) [Spanish Society of Cardiothoracic Imaging]	@SEICAT_RAD	–	–
Sociedad Española de Radiología Pediátrica (SERPE) [Spanish Society of Paediatric Radiology]	@SE.Rad.Ped	–	<a href="https://www.facebook.com/serpe.es">https://www.facebook.com/serpe.es</a>
Sociedad Española de Diagnóstico por Imagen de la Mama (SEDIM) [Spanish Breast Diagnostic Imaging Society]	@SEDIM_RX	sedim.es	–
Sociedad Española de Radiología Vascular e Intervencionista (SERVEI) [Spanish Vascular and Interventional Radiology Society]	@SERVEISoc	serveisoc_	<a href="https://www.facebook.com/servei.org/">https://www.facebook.com/servei.org/</a>
Formación Pre- y Posgrado en Radiología (FORA) [Under- and Postgraduate Training in Radiology]	@formacionrx	–	–
Sociedad Española de Gestión y Calidad (SEGECA) [Spanish Society for Management and Quality]	@SEGECA1	–	–
Sociedad Española de Radiología de Urgencias (SERAU) [Spanish Emergency Radiology Society]	@SERAUWeb	–	<a href="https://www.facebook.com/SERAU-Sociedad-Española-de-Radiología-de-Urgencias-140995426249404">https://www.facebook.com/SERAU-Sociedad-Española-de-Radiología-de-Urgencias-140995426249404</a>
Sociedad Española de Ultrasonidos (SEUS) [Spanish Ultrasound Society]	–	–	<a href="https://es-es.facebook.com/seus.org/">https://es-es.facebook.com/seus.org/</a>

Social media are also used in radiology,<sup>45</sup> especially for training.<sup>15,18,19,46,47</sup> Although the social media mentioned above are the most widely used, there are others with a lower percentage of users, but which have also been used as vehicles for training in radiology, such as Second Life,<sup>48</sup> TikTok<sup>49</sup> and Reddit.<sup>50</sup>

Although social media appear to be good tools for radiology education due to the ability to combine text, image and sound, they are not without potential drawbacks,<sup>19</sup> particularly in relation to trust, recognition of work done, fairness and privacy. The lack of systems able to measure student

progress makes it difficult to assess the validity of social media as effective educational tools.<sup>19</sup> Lack of peer review of content can lead to unintentional sharing of incorrect information between educators and learners.<sup>19</sup> Time spent in the preparation of educational material does not tend to be recognised as academic merit and there are also barriers limiting access to this educational material; the fact that the use of social media decreases with age and the use of one social medium or another is also age-dependent (for example, in the US, 71% of adults aged 18–29 use Instagram, while only 13% of adults over 65 do so).<sup>51</sup>

**Table 3** Social media in medical imaging societies in Europe. Twitter, Instagram and Facebook accounts of the various European scientific societies dedicated to medical imaging [accessed 6 May 2022].

Scientific society	Twitter account	Instagram account	Facebook account
European Society of Radiology (ESR) Cardiovascular and Interventional Radiological Society of Europe (CIRSE)	@myESR @cirsesociety	myESR –	<a href="https://www.facebook.com/myESR">https://www.facebook.com/myESR</a> <a href="https://www.facebook.com/cirsesociety">https://www.facebook.com/cirsesociety</a>
European Society of Emergency Radiology (ESER)	@ESERadiology	eseradiology	–
European Society of Gastrointestinal and Abdominal Radiology (ESGAR)	@EsgarSociety	–	<a href="https://www.facebook.com/esgarsociety/">https://www.facebook.com/esgarsociety/</a>
European Society of Urogenital Radiology (ESUR)	@EsurOffice	–	<a href="https://www.facebook.com/pages/category/Nonprofit-organization/European-Society-of-Urogenital-Radiology-110648267024418/">https://www.facebook.com/pages/category/Nonprofit-organization/European-Society-of-Urogenital-Radiology-110648267024418/</a>
European Society of Thoracic Imaging (ESTI)	@ESTI_Society	–	–
The European Society of Cardiovascular Radiology (ESCR)	@EscrOffice	–	<a href="https://business.facebook.com/myESCR?business_id=958267644198449">https://business.facebook.com/myESCR?business_id=958267644198449</a>
European Society of Neuroradiology (ESNR)	@ESNRad	esneurorad	<a href="https://www.facebook.com/esnr.org">https://www.facebook.com/esnr.org</a>
European Society of Head and Neck Radiology (ESHNR)	@ESHNRSociety	–	–
European Society of Musculoskeletal Radiology (ESSR)	@ESSRmsk	–	<a href="https://es-es.facebook.com/www.essr.org/">https://es-es.facebook.com/www.essr.org/</a>
The European Society Of Paediatric Radiology (ESPR)	@ESPRSociety	–	<a href="https://www.facebook.com/ESPRSociety/">https://www.facebook.com/ESPRSociety/</a>
European Society of Breast Imaging (EUSOBI)	@EUSOBIyc	–	<a href="https://es-es.facebook.com/pg/eusobieuropeansociety/posts/">https://es-es.facebook.com/pg/eusobieuropeansociety/posts/</a>
European Association of Nuclear Medicine (EANM)	@officialEANM	–	<a href="https://www.facebook.com/officialEANM">https://www.facebook.com/officialEANM</a>
European Society for Hybrid, Molecular and Translational Imaging (ESHIMT)	@ESHI_Society	–	<a href="https://www.facebook.com/ESHI.society/">https://www.facebook.com/ESHI.society/</a>
European Society for Magnetic Resonance in Medicine and Biology (ESMRMB)	@ESMRMB	–	<a href="https://www.facebook.com/ESMRMB/">https://www.facebook.com/ESMRMB/</a>
European Society of Oncologic Imaging (ESOI)	@myESOI	my_esoi	<a href="https://www.facebook.com/esoi.society">https://www.facebook.com/esoi.society</a>
European Society of Medical Imaging Informatics (EuSoMII)	@EuSoMII	eusomii	<a href="https://www.facebook.com/eusomii">https://www.facebook.com/eusomii</a>

The most popular social media and their role in radiology training are reviewed below.

## YouTube

YouTube (<https://www.youtube.com>, San Bruno, California, United States) is a video hosting website founded in 2005.<sup>52</sup> Today it is the most used free video sharing platform in the world and one of the most used social media.<sup>52</sup>

YouTube content is organised into channels, with each channel similar to a profile page, and on each channel there is a series of videos. The *videos* tab contains all the videos on the channel, listed in reverse chronological order with the most recent listed first. The *lists* tab contains the *playlists*,

each of which groups videos that share the same theme. In the *community* tab, the person or people in charge of the channel can communicate with the users. In the *information* section, there is a description of the channel and its statistics are shown. YouTube incorporates a search engine to help you find the videos of interest. There are multiple radiology channels on YouTube set up for educational purposes (Table 1).

## Facebook

Facebook (<https://www.facebook.com>, Menlo Park, California, United States) was founded in 2004. It is a social medium in which there are personal accounts called profiles and



accounts of organisations or businesses called pages. Therefore, if for educational purposes, it is recommended to use an organisation or page account to avoid mixing personal and professional information.<sup>46</sup>

Facebook has been used for education in radiology<sup>53</sup> and there are also groups which represent real virtual communities, where their members share common interests. There are numerous Facebook groups on medical topics with widely varying interests. Depending on the settings, membership can be open to the public or restricted. Members interact with posts which can take various formats (questions, comments, links, images, etc). Comments or reactions are generated from these posts which then become a real virtual conversation on a topic of interest. In radiology there are a number of different Facebook groups.<sup>54</sup>

In 2016, Facebook launched its live online broadcast platform known as *Facebook Live*, created for users to communicate with their friends and followers in real time. When you click on “go live” the program requests access to the camera and microphone, and starts streaming video. Along with the video, the platform also has a comments section enabling the sharing of posts during the broadcast. After the live broadcast is over, Facebook automatically sends the recording to the user’s web page for viewing and subsequent comments. In radiology *Facebook Live* has also been used for education.<sup>55</sup>

## Instagram

Instagram (<https://www.instagram.com>, Menlo Park, California, United States, was founded in 2010 and is a social medium based on images obtained with mobile devices (phones and tablets). The user takes an image or video, can then edit it, write a comment, add hashtags, and finally share the resulting image or video in a post. Later, other users can interact with the post by adding comments and reactions. On Instagram, unlike Facebook or Twitter, the image is essential for the post, while the text is optional.<sup>54</sup> By focusing on the image, Instagram becomes an ideal candidate for radiology education.<sup>18,56</sup> Posts on Instagram have limits with regard to content; videos have a limit of 60 s, comments are limited to 2200 characters and hashtags to 30. One drawback of Instagram is that it does not support external hyperlinks.<sup>46</sup> Table 2 lists SERAM’s [Sociedad Española de Radiología Médica (Spanish Society of Medical Radiology)] Instagram accounts and those of its sections, and Table 3, those of the various European scientific societies dedicated to medical imaging.

## Twitter

Twitter (<https://twitter.com>, San Francisco, California, United States, was founded in 2006 and is a social medium based on user-to-user text posts called tweets. These have a limit of 280 characters, which means that Twitter is a short, direct means of communication. When the information you want to give is longer, there is the possibility of linking dif-

ferent publications, creating threads of tweets. In addition to text, users on Twitter can include images and videos, hashtags and external hyperlinks in their posts. Twitter is mainly used in radiology to receive news related to scientific meetings, medical publications and training.<sup>57</sup> Table 2 lists SERAM’s Twitter accounts and those of its sections, and Table 3, those of the various European scientific societies dedicated to medical imaging.

## Discord

Discord is an application originally conceived to create an online social network for PC gamers which was easy to use and had minimal impact on connection performance during the game. It is free and enables high-quality voice, video and text messaging. It is currently the video game industry standard for communication in game tournaments based on eSports and local area networks (LAN).<sup>58</sup>

RadDiscord is a server on the Discord platform created in October 2020 by Dr Grace G. Zhu, then a 4th year radiology resident at the University of Utah (United States). It came about as a direct consequence of the COVID-19 pandemic, as it was conceived to help radiology residents prepare together for their final exam, because of the difficulties with group studying face-to-face. It is the first international online radiology community to promote interaction in real time and allow its members to ask questions, discuss cases, debate difficult concepts, share recommendations and resources, receive advice for professional development and make friends. Many radiology educators and residents volunteer their time to help make this virtual community a success. To be part of it you have to be a verified radiologist and the link to learn more about the platform and request a membership is <https://www.raddiscord.org/><sup>59</sup> (Fig. 4).

## Conclusions

The COVID-19 pandemic has significantly altered the methods traditionally used to teach radiology in undergraduate, postgraduate and continuing education. The internet provides resources to complement radiology training through websites and social media and its use has increased during the pandemic due to physical distancing and the availability of these tools. This article includes a range of different resources of interest for training in radiology. However, in view of the large number of resources available and the fact that it consists of only a selection, the list is obviously partial and subjective.

## Authorship

The author participated in the conception, writing and correction of the manuscript, approving the final text.



**Figure 4** RadDiscord. Server for the Discord platform, whose creation was a direct consequence of the COVID-19 pandemic as an aid for final-exam preparation in the speciality of radiology, and which has become a true online international radiology community (<https://www.raddiscord.org/>).

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## Conflicts of interest

The author declares that he has no financial interests or personal relationships which might have influenced the work reported in this article.

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