

# Organisation and practice of radiological ultrasound in Europe: a survey by the ESR Working Group on Ultrasound

European Society of Radiology (ESR)

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## Abstract

**Objectives** To gather information from radiological departments in Europe assessing the organisation and practice of radiological ultrasound and the diagnostic practice and training in ultrasound.

**Methods** A survey containing 38 questions and divided into four groups was developed and made available online. The questionnaire was sent to over 1,000 heads of radiology departments in Europe.

**Results** Of the 1,038 radiologists asked to participate in this survey, 123 responded. Excluding the 125 invitations to the survey that could not be delivered, the response rate was 13 %.

**Conclusion** Although there was a low response rate, the results of this survey show that ultrasound still plays a major role in radiology departments in Europe: most departments have the technical capabilities to provide patients with up-to-date ultrasound examinations. Although having a centralised ultrasound laboratory seems to be the way forward, most ultrasound machines are spread between different departments. Ninety-one per cent of answers came from teaching hospitals reporting that training is regarded as an art and is needed in order to learn the basics of scanning techniques, after which working in an organ-oriented manner is the best way to learn how to integrate diagnostic US within the clinical context and with all other imaging techniques.

## Main Messages

- *Hospitals should introduce centralised ultrasound laboratories to allow for different competencies in US under the*

*same roof, share human and technological resources and reduce the amount of equipment needed within the hospital.*

- *Technique-oriented teaching, time and examinations are necessary to learn how to use US properly within the framework of organ-oriented training.*
- *A time period of about 6 months dedicated solely to learning US scanning techniques is deemed sufficient in most cases.*

**Keywords** Ultrasound · Europe · Radiology

## INTRODUCTION

The Working Group on ultrasound (US) of the European Society of Radiology was founded in 2009 with the aim of supporting increased quality and visibility of US within radiological departments as well as strengthening the position of US within the radiology community.

Among the many practical goals assigned to the group, one of the most important has been to gather information about the organisation and practice of radiological US in Europe.

This article reports the results of a survey assessing how diagnostic US is practiced and how training in US is organised in radiological departments of European hospitals. Questions were also aimed at evaluating the practice of US within both radiology and other hospital departments in order to understand the relationships among the different users of this technique. A comparison with the results of a previous survey on the US activities within 17 academic radiological departments throughout Europe published in 1999 by Schnyder et al. [1] was also attempted.

## MATERIALS AND METHODS

A questionnaire was developed to obtain data about the practice of diagnostic US within radiology departments in Europe.

The survey contained 38 questions that were divided into four groups:

- (1) Related to the hospital: location; dimensions; presence or absence of teaching duties.
- (2) Related to the workload of US: number of US examinations/year, amount of US equipment available; state of available technology; types of most frequent examinations; organisation of the US laboratory; presence of sonographers; methods of reporting and archiving US examinations.
- (3) Related to the teaching of US to radiology residents: organisation and duration of training programmes; number of examinations to be performed before completion of the training period; presence of training programmes dedicated to sonographers or other non-radiology residents.
- (4) Related to the US examinations performed outside radiology in each hospital; clinical specialists most often involved in performing directly US; availability of special techniques, such as contrast-enhanced ultrasound (CEUS); methods of reporting and archiving US examinations.

The questionnaire was made available online and an invitation to fill it in was sent to all 1,038 heads of radiology departments throughout Europe within the database of the European Society of Radiology. The invitation was repeated three times over a period of 3 months, between June and August 2011.

## RESULTS

There were 123 responses to the questionnaire. Considering that 125/1,038 e-mail messages were reported as “undelivered”, the response rate to the invitation was 13 %. Many responders did not answer all the questions presented in the questionnaire, and some answers and comments were somewhat difficult to understand and evaluate.

### First group of questions

Answers were gathered from different parts of Europe; 63.4 % were from five nations (Germany, Austria, France, Spain and Italy). The distribution according to countries is presented in Table 1.

There were 25 responses (20.3 %) from hospitals with fewer than 400 beds, 52 (42.3 %) from hospitals with

**Table 1** Nationality of responders

Germany (DE)	19
Austria (AT)	18
France (FR)	16
Spain (ES)	14
Italy (IT)	11
Hungary (HU)	7
Switzerland (CH)	5
The Netherlands (NL)	4
Turkey (TR)	3
UUK	3
Czech Rep (CZ)	3
Poland (PL)	2
Denmark (DK)	2
Romania (RO)	2
Norway (NO)	2
Croatia (HR)	2
Portugal (PT)	2
Belgium (BE)	2
Greece (GR)	1
Montenegro (ME)	1
Lithuania (LT)	1
Ireland (IE)	1
Serbia (RS)	1
Sweden (SE)	1

between 400 and 1,000 beds and 46 (37.4 %) from hospitals with more than 1,000 beds. Most answers were from teaching hospitals (91.1 %).

### Second group of questions

Most radiology departments (77 %) have fewer than 10 working US units; 22 % have between 10 and 20 US machines; only 0.8 % have more than 20 machines. Small, portable units are available in 64.5 % of departments, 3D/4D capabilities are present in 52 % and elastography in 48.2 %, and 67.3 % have the possibility to perform CEUS examinations.

Up to 57.6 % of radiology departments perform more than 10,000 examinations per year; between 3,000 and 10,000 examinations per year are performed in 33.1 % of cases; only 9.3 % of departments perform fewer than 3,000 examinations.

Abdominal US is the most frequent exam (51.51 %), followed by breast (14.46 %), musculoskeletal (11.59 %), pelvic (10.88 %) and vascular (10.42 %) US examinations. Contrast-enhanced US (CEUS) studies constitute about 4.39 %. US is used by radiologists in emergency in 96.6 % of cases and in paediatrics in 74.6 %. Comments indicate that most of those who answered “no” did not have a paediatric section in their hospital.

Transvaginal US is used in obstetric examinations by 15.8 % of responders and in gynaecological studies by 50.7 %. Endoscopic US is used by radiologists in 13.4 % and intravascular US in 14.6 %; radiologists are called by surgeons for intraoperative US in 64.2 % of cases.

There were 49 responders who indicated the actual number of US examinations performed/year. The characteristics of hospitals in which the radiology department performs more than 20,000 ultrasound examinations/year are presented in Table 2.

Those who reported fewer than 5,000 US examinations/year are reported in Table 3.

Third group of questions

The first question in this group was whether the hospital was organised with a centralised US laboratory where physicians from all specialties work together.

There were 13/110 positive answers (11.8 %) from Germany (5), Spain (3), Austria (2), Hungary (2) and Croatia (1). All other hospitals have US machines scattered throughout the different radiological and non-radiological departments. The centralised US laboratory is organised together by the radiology and the internal medicine departments in three cases; it is truly multidisciplinary, with all specialties concurring, in three others; it is run by radiology in two. The remaining two positive answers did not provide further detail about their organisation.

The second question related to the role of sonographers. Only 15/110 (13.6 %) department heads stated they work with sonographers. They are located in Spain (3), Germany (2), UK (2), The Netherlands (2), Austria (1), Belgium (1), Ireland (1), Lithuania (1) and Montenegro (1). In all others, US examinations are done directly by the radiologists.

There were 12 comments describing how the work of sonographers is organised. Sonographers do both the examination and the report, with the radiologist checking difficult cases only in four hospitals; sonographers do the studies and the radiologist takes a final look and writes the reports in six; two departments state they use sonographers for vascular examinations only.

The third question related to the organisation of training programmes in US. Radiology residents are trained in 91.1 % of responders. Some centres organise a theoretical course on basic principles of US before starting practical activity. Then, clinical practice is usually performed according to organ/systems training schemes. Residents work under close supervision of a senior radiologist: they approach the patient, perform a preliminary examination and issue a first report, which is then checked by the expert. The aim is to obtain progressive growth of competences: from scanning capabilities, to reporting capabilities, to complete independence.

The length of the period of training within the US laboratory in the various teaching hospitals and the minimum number of US examinations required before the end of the residency period are summarised in Tables 4 and 5.

There was a direct correlation between the number of US exams performed in the department and the depth of US involvement during training: training programmes in the two hospitals where the lowest number of US examinations/year is performed indicate a period of 3 months and 250 and 500 examinations. However, a hospital with a workload of 45,000 US studies per year (in which, however, the examinations are performed by sonographers) suggested only 2–3 months of training and 100 exams before the end of the residency period.

Training is also provided for non-radiology residents in 37 hospitals. It is most frequently offered to internal

**Table 2** Characteristics of the hospitals in which the radiology department performs more than 20,000 US examinations/year (nationality, presence/absence of teaching duties, number of inpatients, number of

US machines available, ratio between number of US examinations performed by non-radiology specialists vs. radiologists)

US exams/year	Nationality	Teaching duties	No. beds in hospital	No. US machines	US done by non-radiologists/US done by radiologists
47,441	ES	Yes	>1,000	10-20	49/51
45,000	LT	Yes	>1,000	<10	50/50
41,834	DE	Yes	>1,000	<10	34/66
41,172	HU	Yes	>1,000	10-20	10/90
30,000	ES	Yes	400-1,000	<10	20/80
27,000	RO	Yes	>1,000	10-20	15/85
25,000	IT	Yes	400-1,000	<10	10/90
22,851	IT	Yes	>1,000	10-20	40/60
22,000	DE	Yes	>1,000	<10	70/30
22,000	ES	Yes	400-1,000	10-20	20/80
21,000	UK	Yes	>1,000	<10	80/20

**Table 3** Characteristics of the hospitals in which the radiology department performs less than 5,000 US examinations/year (nationality, presence/absence of teaching duties, number of inpatients, number of

US machines available, ratio between number of US examinations performed by non-radiology specialists vs. radiologists)

US exams/year	Nationality	Teaching duties	No. beds in hospital	No. US machines	US done by non-radiologists/US done by radiologists
300	DE	Yes	>1,000	<10	95/5
1,400	DE	Yes	>1,000	<10	90/10
2,000	AT	Yes	<400	<10	80/20
2,400	AT	No	<400	<10	0/100
3,500	DE	Yes	<400	<10	60/40
3,700	DE	Yes	>1,000	<10	70/30
4,500	HR	Yes	400-1,000	<10	40/60
4,800	DE	Yes	>1,000	<10	60/40

medicine, gastroenterology, surgery, anesthesiology, vascular surgery and paediatrics. Comments indicate that these radiology courses allow only theoretical teaching, since observation, but not direct contact with patient, is provided for non-radiologists.

All 15 departments working with sonographers provide, or are planning to provide, starting in 2012, training courses for these professionals. These include both theory and practice; the theoretical part is done, in some cases, together with radiology residents.

As an important technical point, it must be noted that US images performed by radiologists are recorded into PACS systems in 85.6 % of cases. Comments on this question indicated that not all equipment is linked to PACS and that only selected images or videos are often archived; furthermore, technical problems in archiving videos have been reported.

A final group of questions pertained to the US examinations performed outside the radiology department in each hospital.

One question asked about the proportion of US examinations performed by radiologists vs. those performed by non-radiologists. European radiologists, as a whole, still perform a higher number of examinations (61.27 %) than non-radiologists (38.32 %). Differences in the percentage of studies performed in the different hospitals are presented in Table 6.

Comments indicate that most OB/GYN, neurology, vascular, urology, internal medicine, anaesthesiology and

gastroenterology departments run their own US units in their wards. CEUS is used in 35.1 % of gastroenterology departments, in 15.1 % of internal medicine, in 10.6 % of transplant units and in 10.4 % of nephrology departments.

The examinations performed out of the radiology department are formally reported in 64.4 % of cases only. Comments indicate that reports are fully stored within the Hospital Information System (HIS) in 31 cases; storage is only partial in 24; no HIS storage is used in 5 cases.

US images obtained outside of the radiology department are recorded into the PACS system of the hospital in 18.3 % of cases only.

## DISCUSSION

Several considerations are raised from the results of this survey.

First, there was a low response rate to the survey itself. There were only 123 answers to the 913 received messages asking for information from radiology department heads (a mere 13 %). It is hoped that this low response rate relates to the many commitments on their side and not to low interest in the role of US within radiology [2, 3].

Second, most responders indicated that US is still an important part of the activities of the radiology department. Only 9.3 % report fewer than 3,000 examinations/year. It must be noted that there may be a bias in these figures, since it is conceivable that responders were more interested in US

**Table 4** Length of the period of training within the US laboratory in the 84 teaching hospitals that reported it

No. of teaching hospitals	Length of training
13	<4 months
38	4–6 months
26	6–12 months
7	>1 year

**Table 5** Minimum number of US examinations to be performed before the end of the residency period in the 75 teaching hospitals that reported it

No. of teaching hospitals	Minimum no. of US examination
20	<500
16	500–1,000
17	1,000–2,000
22	>2,000

**Table 6** Proportion of US examinations performed by radiologists vs. non-radiologists. Although radiologists, as a whole, perform more US examinations than non-radiologists, the table shows there are differences among different departments, with slightly more than 50 % performing more than 70 % of the studies

% of hospital US exams performed by radiologists	No. of radiology departments
≥90 %	25 (20.32 %)
70–90 %	37 (30.08 %)
10–70 %	57 (46.35 %)
<10 %	4 (3.25 %)

than those who did not answer the questionnaire (even if there were responders who indicated that, in their hospital, US is done mostly outside of the radiology department). Most of the workload is due to abdomino-pelvic exams, followed by breast, musculoskeletal and vascular applications. Furthermore, state-of-the-art equipment is used in about 50 % and CEUS can be performed in 64.2 %. Portable machines are available in 64.5 %, transvaginal US examinations of the pelvis are used in 50.7 %, and radiologists are still involved in intraoperative US examinations in 64.2 % of cases. Most departments still have the technical capabilities to provide up-to-date US answers to the requests they receive.

Another consideration relates to the organisation of US within the hospital. In most cases US machines are scattered throughout the different departments, and only 13 hospitals have organised a centralised US laboratory where all physicians from different specialities come to examine their patients. Although centralisation seems the best way to run a US service, there are several factors that can explain why this is not the case, many of which stem from tradition. US laboratories, in fact, commonly arose separately from one another, following the initiatives of the different specialists who started introducing this technique in their practice. Then, there is a disposition to maintain independence and separate departmental income from the activities as well as the desire to control all aspects of patients' care.

Only 15 departments reported they are working with sonographers. Although it is known that in Europe most radiologists perform US examinations directly, it is believed that this figure underestimates the real contribution of these professionals. A possible explanation is that only three hospitals from the UK answered the questionnaire; in the UK sonographers play a major role in dealing with the US workload.

Most answers to the questionnaire came from teaching hospitals (91.1 %). Comments on how training is organised state that US scanning is commonly regarded as an art, taught from maestro to pupil, with progressive growth in scanning and reporting capabilities. In addition, most report

that US is taught within an organ-/system-oriented training system. The “art” of US is highly dependent on the operator's dedication and technical ability, and this has to be properly taught. Additionally, a period of training within a dedicated US laboratory is probably needed to learn the basics of scanning techniques. After learning the technique, working in an organ-oriented manner is surely the best way to learn how to integrate diagnostic US within the clinical context and with all other imaging techniques.

There were 13 teaching hospitals in which fewer than 4 months is deemed sufficient, and in 20 cases having fewer than 500 examinations before the end of the residency is regarded as complete training.

The low number of US examinations performed in some training centres can jeopardise teaching. The recruitment of patients for adequate training can be impossible to obtain in low-volume practices, leading to a further decrease of radiological US for future generations of radiologists. Furthermore, the use of sonographers can make teaching the practical skills of US scanning difficult. In a hospital with high-volume US practice (45,000 cases/year) in which the examinations are performed by sonographers, residents are asked to remain in the US laboratory only for 2–3 months and to perform only 100 examinations before the end of training. When in clinical practice in a hospital without sonographers, these radiologists would not be able to carry out even routine diagnostic US examinations. On the contrary, the role of expert sonographers as a resource to provide practical training to radiology residents has not been considered and can be explored.

The results of this survey show a large heterogeneity in the use of US within radiology throughout Europe. There are hospitals in which the majority of US examinations are still performed by radiologists, and others in which radiologists are left with only a small proportions of studies.

Similar findings were observed by Schnyder et al. in 1999 [1]. From their survey in 17 academic radiology departments throughout Europe, these authors reported that in some nations radiologists had full control of US, while this was not the case in Germany, Austria and Switzerland. The situation seems somewhat worse today, since there are 22 hospitals (18.2 %) in different nations (Austria, Poland, Germany, France, UK, Norway, Switzerland and Italy) in which radiologists perform less than 70 % of all US examinations and 5 (4 %) who answered they do less than 10 % of the studies. Since the answers to the questionnaire were provided by radiology departments, the figures for radiological activity can be considered as precise. On the contrary, it is possible that those answers on the US activities out of radiology can be regarded as an estimate. However, to the best of our knowledge, the data in the survey of Schnyder et al. were also obtained in a similar way, and a comparison can thus be made.

The percent decrease in the number of US examinations done in radiology vs. those performed outside radiology is probably related to a marked increase of the use of US by non-radiology clinicians rather than to a decreased attention to this technique by radiologists. In fact, new specialists, such as emergency physicians and anesthesiologists, are now using this technique as a complement to their visit or as a guide to therapeutic manoeuvres, and the so-called “point-of-care US” philosophy, in which US equipment accompanies the physician at the patient’s bedside to guide his/her therapeutic decision making, is gaining popularity.

An additional point to be considered relates to the recording of US reports and images into the hospital information system and PACS. US examinations performed by radiologists are archived within the PACS system in 85.6 %, while those performed by non-radiologists are stored in only 18.3 % of cases. Furthermore, radiologists provide a formal report in virtually all cases, while examinations performed out of radiology are formally reported in 64.4 %. Costs and technical difficulties in connecting all equipment to PACS and RIS are described as reasons for not recording US images, and this is especially the case for recording of video clips. The use of “point-of-care US” is a further difficulty for connecting equipment to PACS, and, within this framework, the US exam is not regarded as a separate study but as part of the physician visit. However, to have all US images and reports of the patient recorded and available for consultation could greatly help during subsequent studies, and efforts have to be made to develop consensus with clinical colleagues to increase connectivity and to report all US studies, at least as a description within the patients’ charts. Within the framework of the relationships established by the ESR WG in US with the European Federation of Societies for Ultrasound in Medicine and Biology (EFSUMB), it has been agreed to prepare and publish a recommendation about the necessity, for all US examinations, of a formal report and proper archiving of both report and images.

## ACTION POINTS

Two points of action can be suggested.

The first relates to the centralisation of the US laboratory. Although at the moment only a small number of hospitals are working according to this model, radiologists should take the lead in proposing such organisation [4]. This would allow the gathering of all the different competencies in US under the same roof, to share human and technological resources and to reduce the amount of equipment needed within the hospital. In an era of cost containments, a centralised US laboratory can allow each US scanner operate for longer hours and with higher numbers of examinations, resulting in an optimisation of resources. Furthermore, requests to upgrade and/or renovate equipment would possibly be easier if coming from a large

laboratory and shared by different hospital departments. Another advantage would be having people with different backgrounds work in the same environment, thus promoting exchange and integration of their knowledge and possibly resulting in better patient care. It would be easier, in this respect, to prepare institutional guidelines and protocols that place US in the correct perspective towards all other imaging modalities and, most importantly, towards patients’ needs. It is not clear from the survey how this way of working is organised on a day-to-day basis, and especially how emergency services are provided (i.e. if all specialists concur in the emergency or if this is left to radiologists only), but an integrated management and organisational infrastructure bears numerous advantages for cost containment, quality standards and efficiency.

The second point of action relates to training in US within radiology residency programmes. In the opinion of the ESR Working Group on US, radiologists need to develop consensus on how many examinations under tutorship residents have to perform and on how much time they have to spend in ultrasound before the end of the training period. The results of the survey vary widely. However, out of 75 training centres that reported on the number of examinations, there were 39 (52 %) providing figures between 1,000 and 2,000 or higher. Therefore, approximately 2,000 seems to be a figure on which consensus can be reached. This figure also complies with what is suggested by the EFSUMB [5]. This federation provides recommendations about the number of examinations for training in the different subspecialty areas of US: the sum of studies for abdomen, breast, musculoskeletal and vascular training is 1,500, while figures for head and neck are not provided. The length of training is more complex to decide. A distinction has to be made here between the time needed to learn the technique of US scanning and the time needed to learn how to use US properly, to integrate it with other imaging techniques and to provide useful reports. In order to perform US, both approaches are needed. Technique-oriented teaching is necessary to learn how to perform the studies and to identify anatomy and pathology. Time and exams are needed to learn how to use US properly within the framework of organ-oriented training. A period of time of about 6 months dedicated solely to learning the US scanning technique can possibly be considered sufficient, as suggested by 76.2 % of responders. The capabilities of residents to perform US examinations have to be assessed during the training period, especially during and at the end of the technique-oriented part. It is known that the learning curve can vary widely among trainees, and longer times and higher numbers of examinations may be needed in some cases [6]. Additional time should be spent, and exams taken, during organ-oriented training. It must be underlined that organ-oriented teaching needs to include the proper role of US in each

subspeciality and also take into account technical advances such as CEUS, 3D/4D and elastography and to use them when needed.

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